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ENGINEERING & MINING JOURNAL-PRESS

A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

Why Mining Languishes in Brazil, by T. T. Read

With views of operations at the St. John del Rey and Ouro Preto gold mines

Air Cooling Plant at St. John del Rey—the Deepest Mine in the World

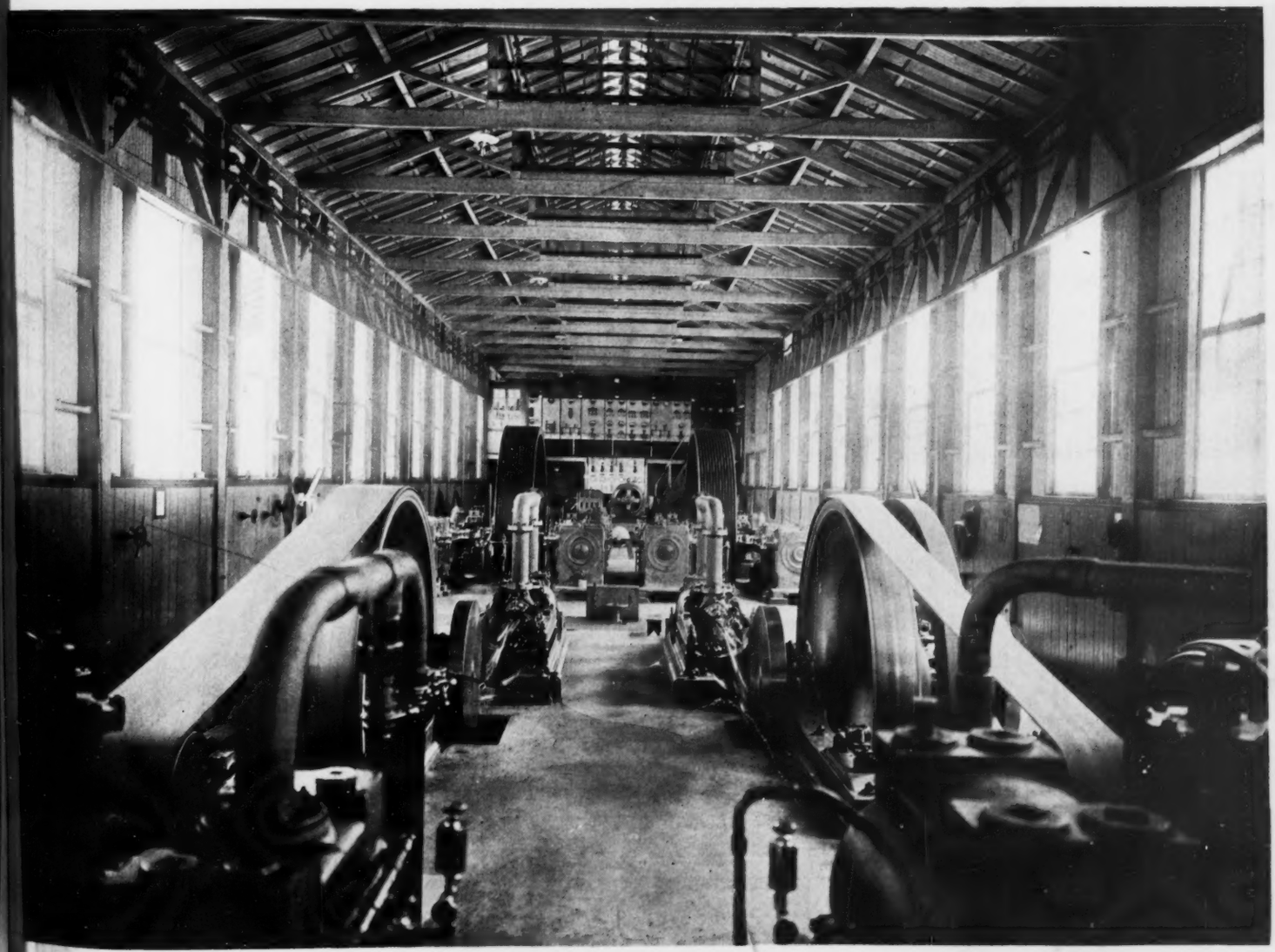
Photographs

The Chino Enterprise—V, by T. A. Rickard

Concentrating the ore at Hurley and smelting at El Paso

Monthly Statistics of Metal Prices—The Mining News

Compressor room of the St. John del Rey Mining Co., Morro Velho, Brazil. Note the variety of equipment



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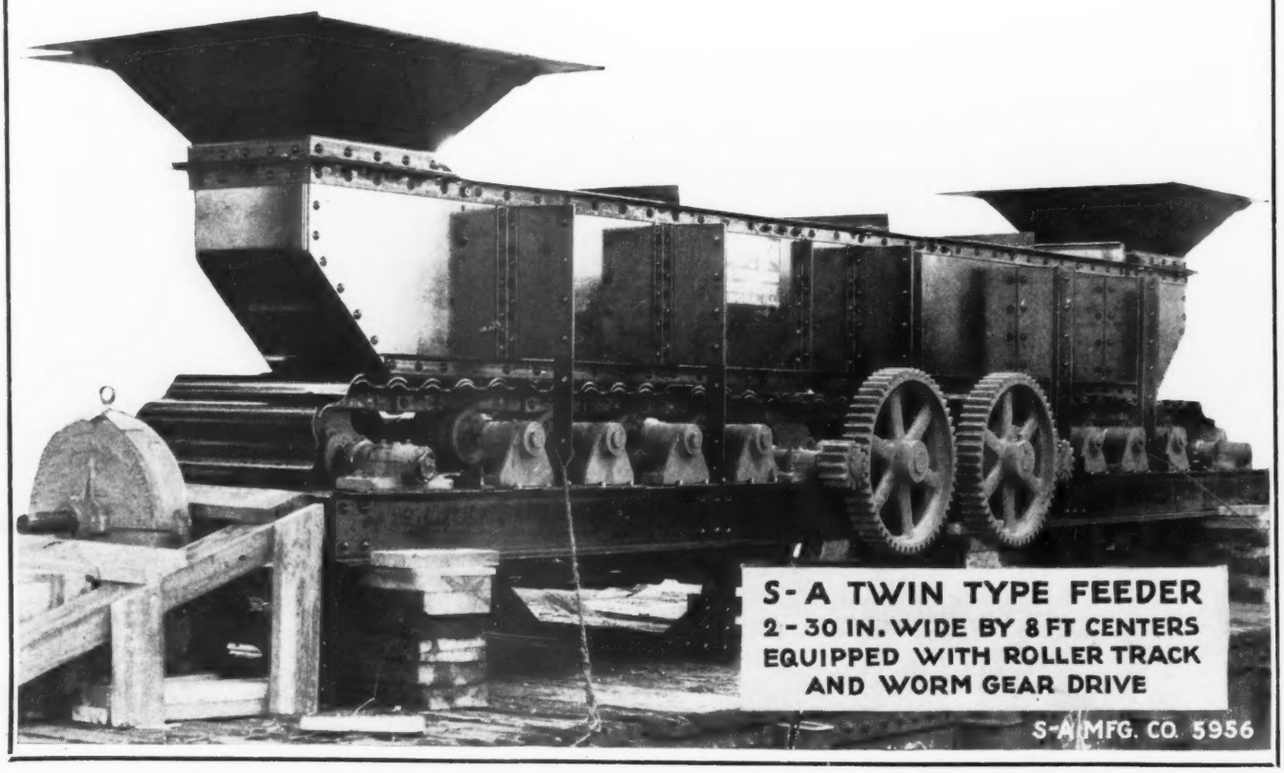

ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

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The Mining Journal-Press

Engineering and Mining Journal-Press is a consolidation of *Engineering and Mining Journal* and *Mining and Scientific Press*, effective April 1, 1922.

Engineering and Mining Journal was founded in 1866 as the *American Journal of Mining*, with George Francis Dawson as Editor. In 1869 the name was changed to *Engineering and Mining Journal.*

Publications which have been absorbed are: 1875, *Coal and Iron Record;* 1877, *The Mining Review* (Denver); 1879, *The Polytechnic Review;* 1902, *Mining and Metallurgy;* 1906, *Mining Magazine;* 1917, *Engineering and Mining World.* The successive editors have been—Rossiter W. Raymond, Richard P. Rothwell, Fred Hobart, David T. Day, T. A. Rickard and W. R. Ingalls. In 1919 J. E. Spurr succeeded Mr. Ingalls.

The Mining and Scientific Press was established in 1860 as the *Scientific Press.* Three years later "Mining" was added to the title. The successive editors have been Almond D. Hodges, Charles G. Yale, J. F. Holloran, and T. A. Rickard.

The staff of the *Engineering and Mining Journal-Press* consists of J. E. Spurr, Editor-in-Chief; T. A. Rickard, Contributing Editor, San Francisco, Calif.; George J. Young, Associate Editor, San Francisco, Calif.; A. H. Hubbell, Managing Editor; E. H. Robie, F. E. Wormser, A. W. Allen, San Francisco, Calif.; A. B. Parsons, W. N. P. Reed, Assistant Editors.

Marketing Mining Stocks

A BROKER WHO SPECIALIZES in mining stocks writes us commending us for our attitude against unsound or unscrupulous mining promotions. At the same time, he says, the market for legitimate mining stocks has almost disappeared in Wall Street. Between the censorious attitude of investment advisers and financial writers toward mining stocks in general, and the exploitation of the greedy and ignorant public by stock sharpers with shoddy mining schemes, it seems to him that the middle ground is squeezed pretty hard—the ground occupied by the mining stocks of real investment or fair speculation value, sold on these bases, and without manipulation.

In truth, the problem is one that might well be considered. The public should invest in mining enterprises. No great industrial enterprises nowadays can exist without widespread public ownership. The Steel Corporation, the Pennsylvania Railroad, the American Telephone & Telegraph Co., Armour & Co., are continually calling attention to the thousands or hundreds of thousands of their stockholders, showing that except for the public purse, and indeed the purse of the relatively small investor, they could not exist. How is the public to know what to buy in mining stocks? The right-minded public likes to invest for profit—for dividends and to take a chance. The element of speculation is inherent in enterprise—in foreign trade, farming, or the automobile industry, quite as much as it is in mining; and this element is a legitimate one for the investor to accept. However, he must get the best information, so that he can judge as well as may be of the kind of outlook into which he is buying, what is assured, what is reasonably to be hoped, and what is purely speculative. He has little chance to get this information nowadays. Only the largest mining enterprises are listed on the New York Stock Exchange: and in many of these the element of speculation is as large as for many of the little ones outside.

Is the idea of a Mining Stock Exchange one which has anything to commend it? Such an exchange might have a board of governors composed of mining engineers, which would permit only legitimate buying and selling of mining stocks which it had admitted to listing.

What's Wrong With Assaying?

WHY THE UNPOPULARITY of assaying? asks a member of the crucible and tong fraternity, who is contentedly pursuing his calling. After weighing—as his habit is—all the reasons he has ever heard and rejecting them, he concludes that it is because the assayer is the "champion realist in the world of illusion—the boss dissipator of rosy dreams," and that few like a job where they are constantly disappointing others. But such a theory is spun too fine; most people are not so tender-hearted.

In the first place, there is nothing wrong with assaying—unless it be the assayer. The man must fit the job. Assaying is a highly important part of the work about a mine and mill. It calls for skill and deftness that practice alone can give. The amount of technical knowledge required, however, is often small, except in the custom assay office or the smelter laboratory, where new ores are constantly testing the assayer's knowledge of the reactions that go on within the crucible. Sometimes the assayer works by cook-book recipes, as it were, possibly handed down by his predecessor, and if the ore changes little, the results will usually pass unchallenged. Then, too, assaying is often routine work of a deadly monotonous kind. So it is easily seen how a man with an active mind will find such an occupation tiresome. Only a certain type—which is scarce among those technical men who aspire to plant management—can contentedly put his nose to the grindstone of assay laboratory routine and grind away, day in and day out, week after week, Sundays included, perhaps with only those holidays that are occasioned by the Fourth of July and Christmas and the chance flooding of the mine or the breakdown of the mill.

This unwillingness increases as the opportunity for advancement grows remote. The smelter chemist is in line for superintendent, but the mine superintendent rarely is taken from the laboratory. Where mill work involves much experimenting, the assayer may get a chance to use his brains, and more than one has worked his way into the position of mill foreman or superintendent on the strength of his laboratory record. Where such opportunity is lacking, however, the young technical graduate in the laboratory is apt to visualize only a life of weighing buttons as he looks ahead, unless

he hopes to be a custom assayer. It all depends on the type of man—there is nothing wrong with the work any more than there is with a hundred other jobs that require little mental exertion.

Experience in assaying, however, is valuable and frequently comes in handy in examining and sampling mines and prospects. Most young engineers are not averse to having a certain amount of it, or should not be. "Once an assayer, always an assayer" is an expression often heard, though of course untrue. But the phrase has doubtless served to scare more than one graduate away from the occupation, and, in general, indicates the attitude of the technical man toward the pursuit.

Grown Gold

IT IS NOW MONTHS since we received a pamphlet on "Grown Gold," sent us by the author, Mr. Peter McFarlane, of Central City, Colorado, with his compliments. We have held it meaning to look it over carefully some day, and we have done so today. It is worth reading. One does not have to go further than the dedication to know the author as well as need be, and to get a key to the pamphlet:

"To my daughter, Yetta Katrina, who so persistently opposed its publication, claiming as a reason therefor the opinion of sixteen hundred million human beings against it on the one side, and one lone feeble voice its only advocate on the other, but who nevertheless patiently aided in its preparation, this little pamphlet is most graciously dedicated. Its Author."

Here we have sturdiness, humor, kindliness, common sense, and a poetic sense. We do not need to study the handwriting.

The pamphlet itself partakes in all the qualities of the dedication, and pretty faithfully according to the formula there displayed.

It is a sort of prose saga of the gold problem, in thirteen short chapters. The first chapter is a commentary on Job's statement that "gold is where they fine it," which the author, interpreting the statement to mean that "gold is where they find it," proceeds to controvert, with what must be daring iconoclasm and humor in Central City:

"As a dramatist the great moral poem that bears his name ranks its author as the original Shakespeare. But man has ever been prone to shine or become an authority in matters about which he knows very little and the world knows nothing. Such was the temptation that induced him to exploit the field of metallurgy. The people were looking for information. Job supplied it. It satisfied the gold seeker who accepted it as truth, and indeed many of our most eminent mining engineers at this time quite agree with the conclusion therein involved. Much of the current standard literature written about the geology of gold was produced by men who never saw an auriferous fissure and yet, being noted in other lines of thought, like Job, foolishly imagined what they might say about gold mining could only be regarded as the truth. Our text books in regard to gold are largely replete with statements of would-be authority from men unqualified, from lack of opportunity, to express an opinion—men whose vanity, like Job's, led them into a field of thought where 'angels fear to tread.' Perhaps no words ever written have been such a stumbling block to mining progress for thousands of years as his misleading, epigrammatic, uncanny, flippant, unguarded, unwarrantable and, it must be added, untruthful statement, 'Gold is where it is found.'"

In the second, third and fourth chapters he settles down to business and offers circumstantial testimony that gold has "grown" in old mines left standing for fifteen or twenty-five years; and this evidence is given with great anecdotal vigor. In the succeeding chapters he writes on gold in many of its phases, historical, economic and human. He dwells on the current delusions as to existing processes of transmuting base metals into gold; of the ransom in placer gold that Cortez exacted from Montezuma; of the discovery of gold in Colorado by Gregory, a highly poetical chapter well worth reading; on the theories of gold formation, commenting sagely and unfavorably on the theory of "infiltration"; on the gold reserves of the United States, and the problem of the future gold reserves of the world; he looks (pessimistically) into the future of gold mining (and that of other metals); and winds up with a sort of peroration, from which we select as a specimen paragraph:

"Alas for the nation that allows its gold reserve to diminish and disappear. It not only destroys its commercial importance, it forebodes the physical and moral decadence of its people. Gold will exist and grow without the co-partnership of man, but man can neither flourish nor exist without the co-partnership of gold."

Like the prose of Dickens this runs easily to blank verse:

"Alas for the nation that allows its gold reserve
To diminish and disappear. It not only destroys
Its commercial importance: it forebodes
The physical and moral decadence
Of its people. Gold will exist and grow
Without the co-partnership of man, but man
Can neither flourish nor exist without
The co-operation of gold."

The main thesis of this earnest and at the same time whimsical pamphlet is really to prove that in old workings which stand above the water level, exposed faces of ore become much richer in gold after a lapse of years, and that a lack of a perception of this accumulation (or, as the author calls it "growth") has led to many costly blunders, disappointments, and misunderstandings. He says:

"Every gold bearing mine will produce a grown gold if proper conditions exist. The conditions referred to as necessary to its growth production are, first, a vein of gold bearing ore; second, development, work-shaft, levels, mining; third, an abandonment of the mine during which time its mineral faces remain undisturbed; fourth, only that portion of the mine standing above water level to be considered. Water trickling from the vein face and its exposure to the atmosphere are conducive, and will in fact, if unmolested, in time, produce a grown gold. The grown gold is what this article hopes to direct the miner's attention to, because it has hitherto and up to this time been a dangerous, unknown, and misleading element in all gold mining calculations and can be avoided."

And the practical lesson he wishes to broadcast:

"If now, a lease in an abandoned mine, long idle, were being considered and an assayed test of the ore required, the first duty would be to blast away a few feet of the exposed face, and then sample from a ground left as nature prepared it before the advent of man. If of too low a grade, one need not mind; if of a good enough grade, one has a reasonable right to expect a continuance of its value in operating the mine and it usually does continue."

With this general conclusion and with the advice derived therefrom we desire to place ourselves in agreement, and this makes two against sixteen hundred million, instead of allowing Mr. Peter McFarlane to bear the brunt of battle alone. Moreover, we are inclined to

believe that the cases selected by Mr. McFarlane are valuable data as to the time required for this enrichment of mine faces in gold by percolating waters; indeed, we should like to mention this data here more in detail, but for lack of space. And we could add one very striking anecdote from our own experience along the lines which Mr. McFarlane relates. The fact seems to be—indeed it is evident—that water saturating an exposed ore and making its way to an exposed face of ore, and there evaporating, at or near the surface, deposits gold which it had taken into solution; and in the course of fifteen, or twenty-five, or fifty years the ore adjacent to that exposed to the air will be very much enriched in gold content. Mining engineers know this in a general way, and are usually careful to clean off the outer part of an exposure before cutting samples. In some cases, however, they should discard the outer foot or two, at least.

The Mine Timber Census

EARLY in 1924, the U. S. Geological Survey will initiate an inquiry to determine the amount of timber used by the mining industries. A questionnaire will be sent out to all mining companies and an estimate will be made from the answers that are received. Unless the effort meets with the support of the individual mining companies, the result will be of little value. Undoubtedly mining companies have been harassed by numberless demands of similar kind, but in this instance the information will be useful to the mining industries, and we bespeak patience and a general compliance with the efforts of the Survey. A national stock-taking and inventory are useful in giving quantitative data. By whole-souled co-operation it can be accomplished at minimum expense.

Copper, Cotton, and Cattle

ARIZONA was for a long time dependent upon the mining industry for its prosperity. In particular the copper-mining industry has steadily developed in that state, and it now is and for a long time to come will be the leading industry. Gold and silver mining has waxed and waned throughout the mining history of Arizona. Both contribute to the romance of mining and afford opportunity to the mining adventurer. Their possibilities are far from being exhausted. Low copper prices accompanied by the twin difficulties of shutdowns and curtailment of production have beset the copper industry at different times and have resulted in periods of depression that have adversely affected the state, for it has largely relied upon the purchasing power of the mining districts. This condition is passing with the growth of agriculture. Stock raising has been a background of the mining industry, but this industry, although important, is scattered and of relatively small purchasing power. On the other hand, the Salt River project, comprising over 200,000 acres of agricultural land, has brought into the state a return of approximately $18,000,000 for the current year. The principal crop is cotton, with a total value of $8,500,000. Alfalfa returned $3,000,000 and cantaloupes $1,334,000. This production was made by 5,000 individual owners, the average size of a farm being slightly over forty acres. Thus, although copper and silver prices are low and mining is depressed, agriculture is on the crest of a prosperity wave.

The economic well-being of a state is dependent upon a diversity of industrial interests, and we are glad to record that the prosperity of Arizona is now derived from copper, cotton, and cattle. The result of this should be materially to reduce the taxation load carried by the mining industry, which has been, in our opinion, rather severely penalized.

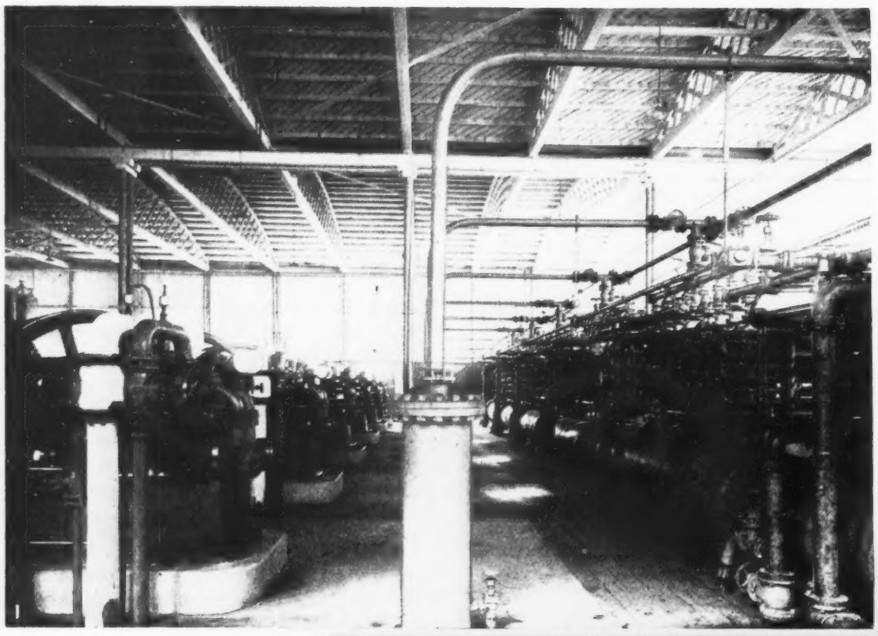
Earrings and the Mining Industries

AS WE SETTLED in our seat in the train on our way to the big city a young lady brushed by, and we looked up as she swept on beyond the smoking compartment. We noted an amazing detail. Two little ivory elephants dangled from her ears. In a flash we pictured the elephants grown to enormous size and ponderously walking along swinging the young lady by her ears between. Then we visualized the mining industries in a similar predicament swept along between the twin elephants of high taxes and high costs. All of the mining industries are affected by these two pachyderms. Some parts of the industries, notably the silver and copper miners, have to stagger along under the additional handicap of the rhinoceros of low prices. If these three pachyderms were of modest proportions such that they approximated the size of mantel ornaments, the industries might carry them in much the same way that the young lady sported her unique earrings.

Speaking seriously, however, our mining industries are suffering from the same difficulties as the wheat farmers. These are excessive taxes, high costs of production, and low prices. Other industries are in the same predicament. Economic readjustment is the need of the times. The Federal Government has accomplished a beginning. More than anything else is the necessity for state and municipal governments to do likewise. So long as excessive taxation prevails, low freight rates are impracticable. So long as state and municipal expenditures continue at existing rates, high taxes will continue. The competition for labor has been especially keen, but farmer and miner must suffer unless governmental work is co-ordinated with respect to industrial requirements. Slow improvement of the general situation is to be expected, but it could be accelerated by judicious economy on the part of our governmental agencies.

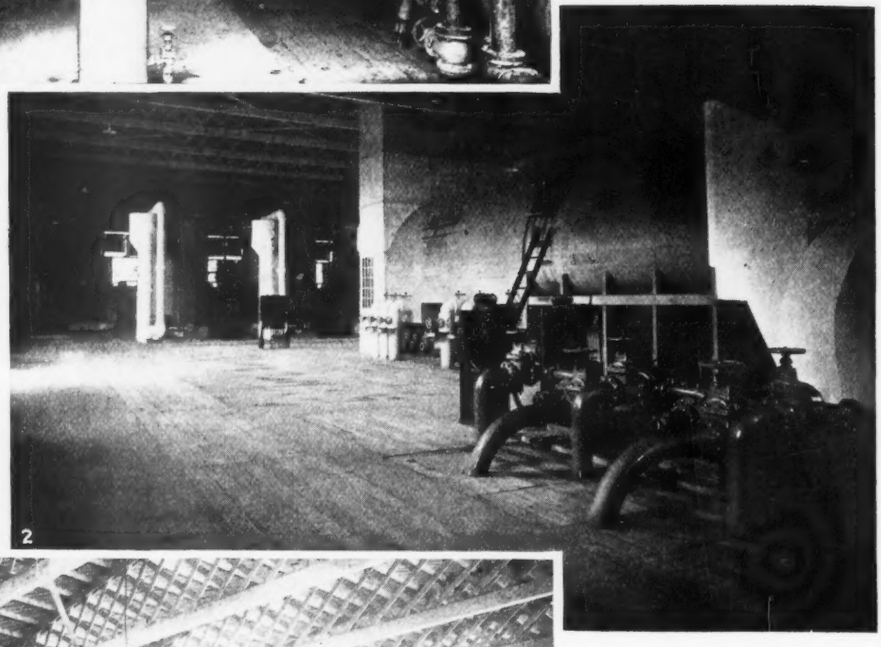
A Reward for Mechanical Improvement

IT IS INTERESTING to hear that Charles Markham, of Chesterfield, England, has offered a prize of £1,000 for the best electric-storage battery locomotive for use underground in coal mines. The competition will be supervised by the Mines Department and is open to manufacturers, or designers who have arranged for the manufacture of their designs. Competitors may be of any nationality. The donation of so attractive a prize, it is hoped, will stimulate the development and improvement of such important mining equipment as storage-battery locomotives. Credit is due the donor not so much for the gift as for his broad-mindedness and desire to see mining practice bettered. Coal mining and metal mining have many common needs, and it is likely that improvements in equipment that result from this prize will benefit the latter industry to a measurable extent.



1. Compressors and water coolers

The St. John del Rey Mining Co., to improve underground working conditions, decided to lower the wet-bulb temperature of the mine air by drying it before sending it into the mine. It therefore built the plant shown on this page to dry the incoming air by cooling it.



2. Air coolers

This plant has a maximum capacity for heat extraction of 100,600 B.t.u. per minute. This is equivalent to cooling 5,040 lb. of air per minute from 72 deg. F., wet bulb, to 43 deg. F., saturated. The plant represents a capital outlay of about £130,000.

3. Motor and compressors

The principal effect of the refrigerating plant has been to make the air arrive at the 6,426-ft. level with 66 gr. moisture per pound of dry air less than it had before the plant was started. This corresponds to about 12 per cent less humidity and about 9 deg. F. lower wet-bulb temperature.

Mine air cooling plant at the deepest mine in the world—the St. John del Rey Mining Co., Morro Velho, Minas Geraes, Brazil

Why Mining Languishes in Brazil

Social, Political, Economic and Geologic Reasons for the Existing Situation

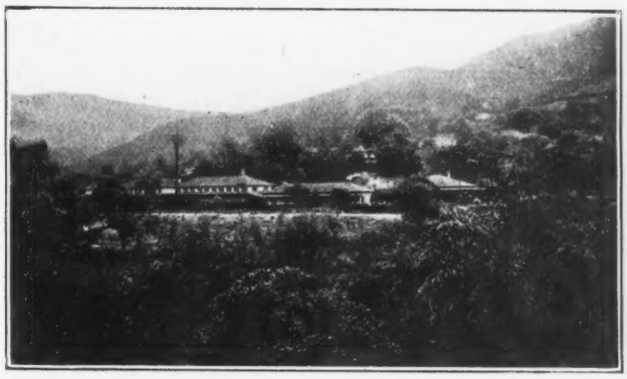
By T. T. Read
Mining Engineer, Duluth, Minn.

THE FIRST IMPRESSION of the mining engineer visiting Brazil is a feeling of surprise that the mining industry of so large a country is so small. Development by the white man began much earlier in Brazil than it did in the United States and slaves from Africa were being imported into Brazil sixty years before Jamestown was founded. Brazil is larger in area than the United States (excepting Alaska) by more than 250,000 square miles, but the present-day mining industry, whether regarded by tonnage or by value of output, is very small. Manganese production does not exceed 500,000 tons per year. The coal production is about 300,000 tons a year, and there seems little probability that the industry can be developed extensively. Iron-ore production is only a few thousand tons a year, and there is much doubt as to the possibility of its being developed to anything large except on the basis of exporting ore to countries where fuel is available for its smelting. There is no copper, lead, or silver production in Brazil and gold production, which was estimated at $25,000,000 a year in the early part of the eighteenth century, has sunk to $2,000,000. The total production of all mineral products in Brazil in a year amounts to less than a million tons, or about one-half the phosphate rock production of Florida. This naturally gives rise to the query: "How does it happen that so large a country, which has been actively exploited for so long a time, has so small a mineral industry?"

The manganese-mining industry is now first from the standpoint of tonnage and value, having developed from almost nothing in a decade. Although there are no statistics as to production it is possible to depend on the export figures, as there is no consumption of manganese in the country, and the records are carefully kept on account of the export tax. In 1920, about 450,000 tons was exported, and in 1921, 275,000. Prior to 1915 the manganese industry in Brazil amounted to very little, but the interference of the war with shipments from Russia caused it to increase very rapidly. The future is obviously somewhat uncertain, because there is so much manganese in the world that the greater part of production will tend to come from the country that is best situated to sell its ore in the American market. The manganese mines in Brazil are about 300 miles from tidewater, and the railway rates are high, whereas the Russian deposits are about 130 miles from tidewater and some of the Indian deposits are as little as 30 miles from tide. What the position of the industry in Brazil will be after conditions in Russia become normal is difficult to foresee, but the fact that the United States Steel Corporation has bought the largest manganese mine in Brazil will inevitably be a strong factor in future production.

The coal-mining industry is second in tonnage, with an output of about 300,000 tons a year. The coal, however, is of poor quality, and transportation costs so much that in most parts of Brazil it is cheaper to burn imported coal. The coal-mining industry was thoroughly studied by the White Commission, and there seems little reason to believe that it is likely to develop much beyond its present magnitude in the near future.

From the standpoint of tonnage, the discussion of the mining industry in Brazil has practically been covered by these two, but from the standpoint of value gold is important. Gold mining was at one time the most important industry in Brazil, and the total amount of gold that has been produced is large. The discovery of gold in Brazil, about 1700, served, as it has in so many other countries, as the magnet to draw a large number of people to the country and played an important part in its general development. That part of Brazil in which gold occurs is a region of very ancient rocks, and the gold was found in placers that had accumulated through the ordinary process of rock decay. These were worked with slave labor, and in traveling over the region it can be seen that practically the entire surface has been worked over. There are no deep gravels that I know of, and my general impression is that in a broad way the placer deposits of Brazil have been largely worked out. There are, of course, many small operations still going on, just as there still are in the western parts of the United States, but in general the period of placer mining for gold is over. There does not seem to be much probability that dredging deep gravels can be developed in any extensive way in Brazil, because the rivers of the region are not large and usually have very steep gradients, so that there has been little opportunity for extensive gravel deposits to be produced.



Morro Velho hospital. Note the tropical vegetation.

As usual, the period of placer mining was followed by one of lode mining, but with the exception of two mines that are still working, this is also largely over. Some of the lode mines were very rich, but in a number of instances the rich orebodies were worked out, and in other cases the work extended to a depth at which the trouble from excessive amounts of water and bad ground was the source of so much expense that the operation was not profitable. A remarkable exception is the Morro Velho mine of the St. John del Rey Mining Co., which has the most uniform and persistent orebody in the history of the mining industry. It has already been followed to a depth of 6,726 ft. below the

surface, making it the deepest mine in the world, and the orebody is remarkably uniform in size and in good content. From the standpoint of tonnage it is not a large mine, as only 500 long tons a day is being milled. It has, however, been very profitable.

"Richest Place on the Globe"

The only other gold mine is that of the Ouro Preto Gold Mines, Ltd., a short distance east of the city of that name. This was the first city in Brazil, having been established in the midst of a region of rich placers at the beginning of the eighteenth century. Between 1730 and 1750 Ouro Preto "was reputed the richest place on the globe," according to Mawe. The lode mine just mentioned was opened in 1817, and at present is producing about 250 tons a day. The ore mined averages about $7 a ton. The orebodies are so irregular that it does not pay to take out ore containing less than $5 a ton. On the average, the mine has not been very profitable, but at present it benefits from the fact that the paper milreis, in which wages are paid, has greatly declined in value with relation to gold.

Diamonds are next after gold in value of production, in all probability. The only figures which throw any light on the production of diamonds are the export figures; but because a good many diamonds are cut and sold in Brazil, there is no way of ascertaining what the relation is between exports and the total production except in the case of "carbons" or the black diamonds used for drilling purposes, of which there is no consumption within the country. Exports of carbons in 1920 amounted to 3,000,000 milreis, and exports of diamonds for the same year amounted to a little more than 5,000,000 milreis (the value of the milreis in 1920 averaged 13¾c.). These figures must be taken as only a general guide, because diamonds, on account of the high value, are naturally smuggled. With the exception of the Companhia Braziliera Diamentifera, which is washing 100,000 cu.m. yearly, and which reported a profit of 2 per cent on its capital in 1921, all the diamond producing operations in Brazil are in the hands of "natives," who carry on primitive operations in a small way. My own impression is that diamond mining is being done in about the only practicable way. This impression would seem to be confirmed by the fact that many projects for working diamond deposits on a large scale so far have not been successful.

Many Mineral Products of Minor Importance

These substances close the list of those of which it can be said there is any mining on even a moderate scale. Small quantities of a great many other substances are produced, such as monazite sand, tungsten, platinum, mica, rock crystal, zircon minerals, and a variety of semi-precious stones, such as aquamarine, tourmaline, agate, and a number of others. In the case of the monazite sand and the zircon minerals, probably nearly the entire production is exported. In 1920, a total of 1,153 metric tons of monazite sand was exported, and 541 metric tons of zircon minerals, 33 tons of agate, and 40 tons of rock crystal. Exports of semi-precious stones slightly exceeded the declared value of the monazite sand exports, but a great many precious stones are cut in the country, so that production is larger than exports in every case.

On considering the question why the mining industry in Brazil is so small, certain handicaps to development at once appear. One of these is the question of land titles. It is difficult to explain so complicated a matter as the subject of property titles in Brazil in a brief way and without inserting reservations and qualifications. Roughly, the situation is essentially as follows: Under the Brazilian law the owner of a property is restricted as to the disposition he can make of it by will. The result was that in many cases no will was made, and the property descended to a large number of legitimate and illegitimate children and other heirs. In many cases no subdivision of the estate was made, but the property was held in common. A piece of land, instead of having only one legal owner, may, therefore, have a great many undivided interests, much like shares in a corporation. On attempting to buy a property inquiry may indicate that certain people own it, but as soon as negotiations are started with these ostensible owners a good many other claimants appear, and sometimes the greatest difficulty is experienced in dealing with them. One lawyer in the State of Minas Geraes, who has had a great deal of experience with negotiations and business of this character, was reported to me as having said that he could guarantee to hold up any proposed deal in that state involving 40 contos ($10,000 or $12,000 at normal exchange) by discovering an heir of the fourth or fifth generation back.

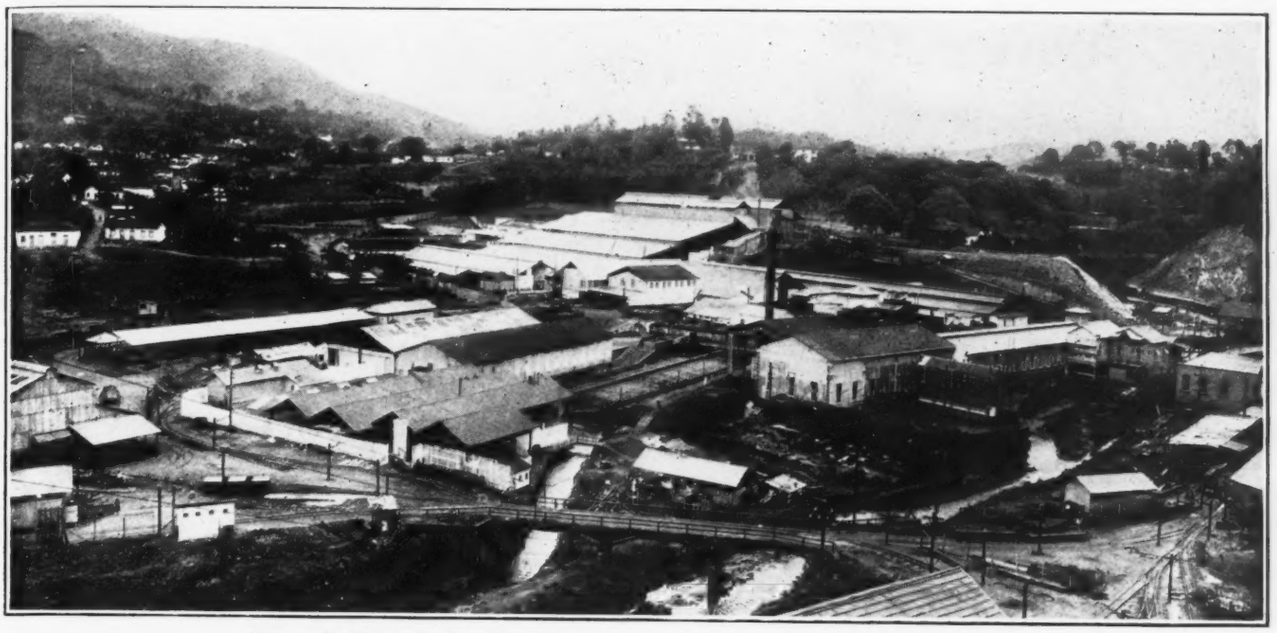
Inheritance Laws a Big Hindrance

Persons who own an interest are difficult to handle, because under the law of Brazil they can enter on a property and do practically what they will with it. An example of the way this situation works out is the case of an Italian who bought part of a property for farming purposes, and apparently secured a clear title. After several years a nickel deposit of considerable prospective value was discovered on the part which the Italian had bought; whereupon heirs to the estate from which he had bought his property started suit and finally had the sale to the Italian annulled, with the result that he lost his property and all the improvements he had put on it.

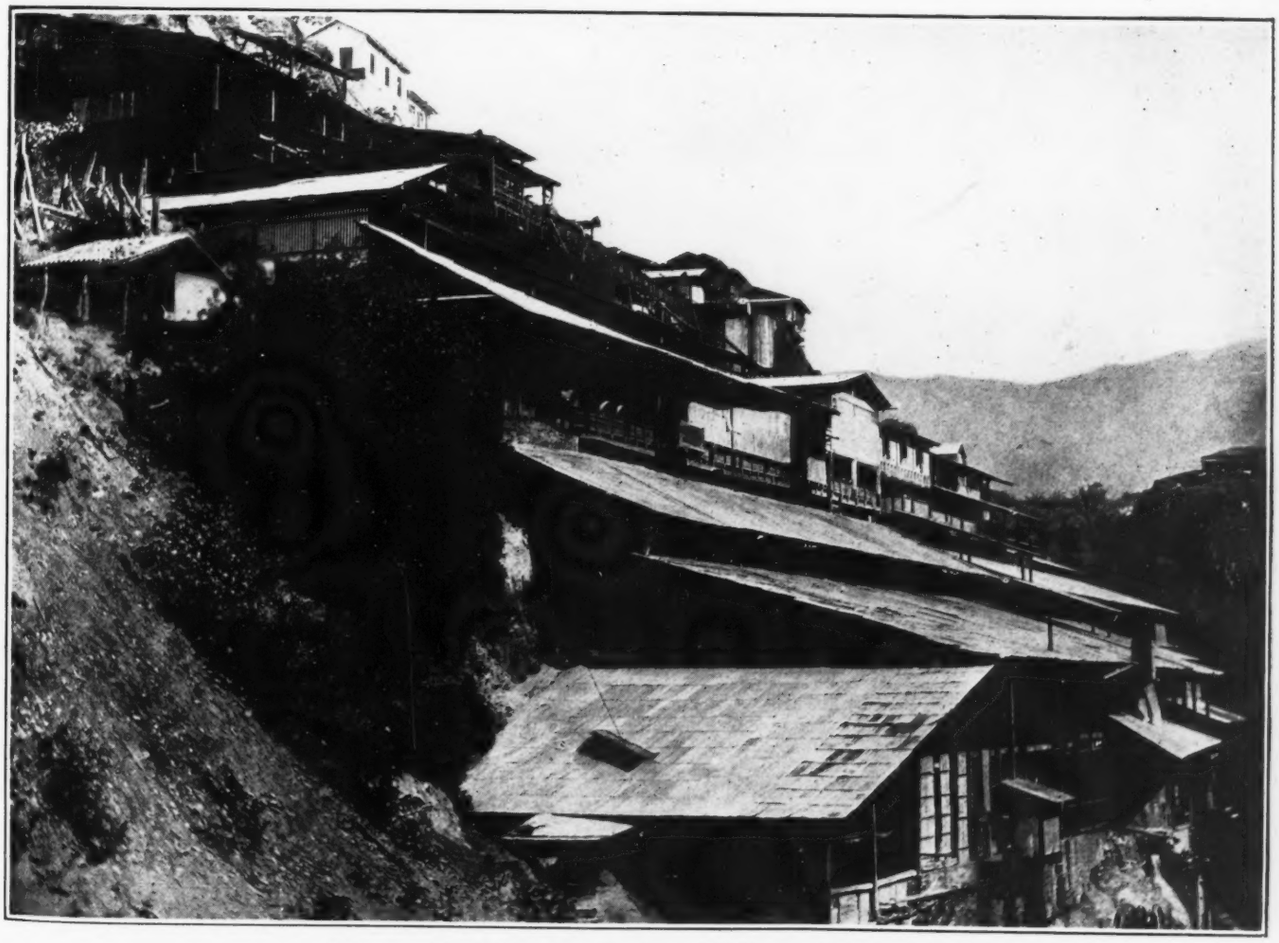
Burdensome and Varied Taxes

A second important factor in hindering the development of mineral enterprises in Brazil is the system of taxation in force there. As is generally true in countries where large land owners are the principal force in the tax-imposing body, there is little taxation on land, and the national and state revenues are derived chiefly from taxes on imports and exports, and consumption and stamp taxes. Import duties under the constitution of Brazil go to the federal government, but export duties go to the states from which the exports have their origin. The constitution of Brazil was modeled on that of the United States, and there is in it a provision expressed in almost exactly the same language as that clause in ours which has been interpreted to forbid any taxation to be laid on commerce between states. It seems reasonably clear to the outsider that it was the intention to make a similar provision in Brazil, but the state authorities have not so interpreted it, and if iron ore from the State of Minas Geraes is sent a few miles across the state boundary into Sao Paolo for smelting, an export tax is levied upon it. Whether or not this taxation is legal is a matter of a good deal of dispute in Brazil, and the present Chefe do Cabinet of the Minister of Agriculture and Commerce (the equivalent of an assistant secretary here) has written a book on the subject. Nevertheless, the principal thing is that the export tax

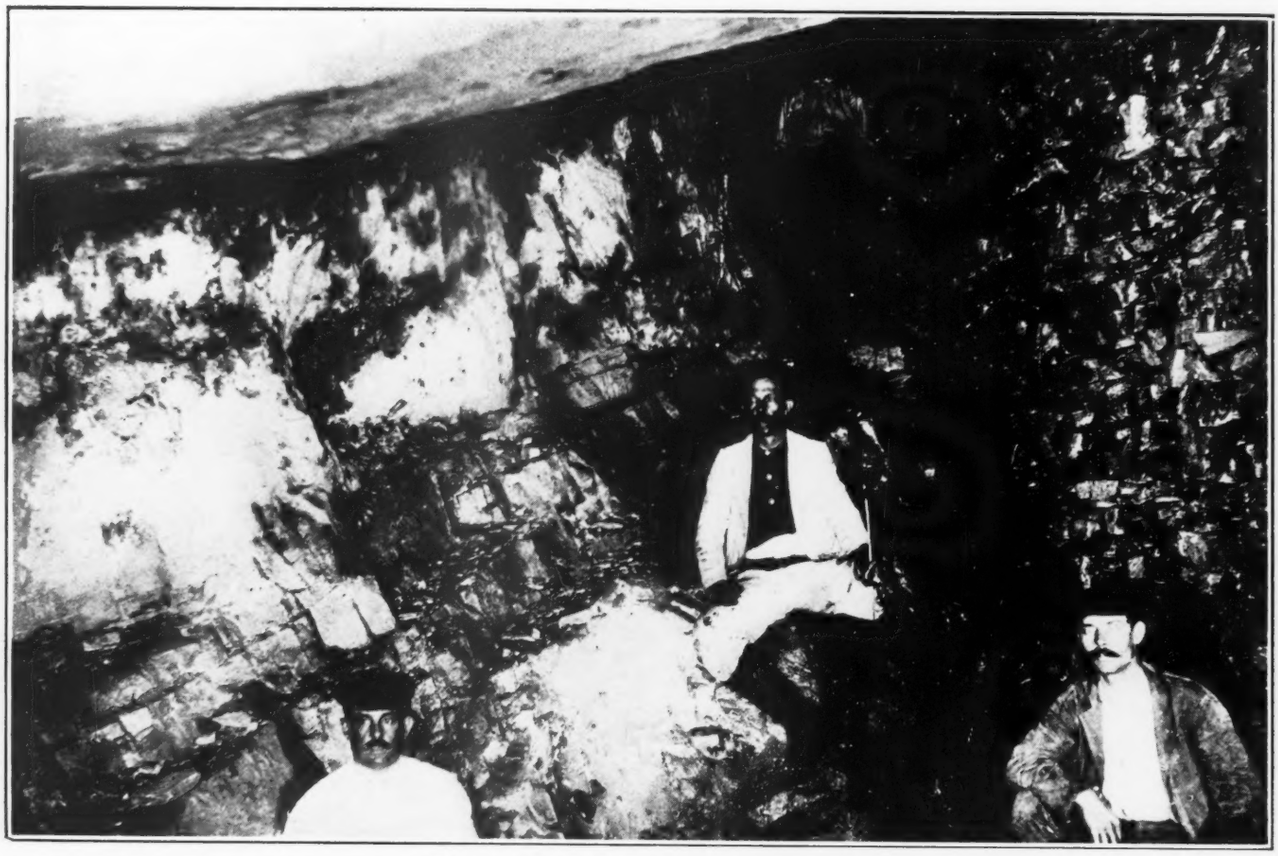
Views of Gold Mining Operations in Brazil



General view of the St. John del Rey surface works at Morro Velho.

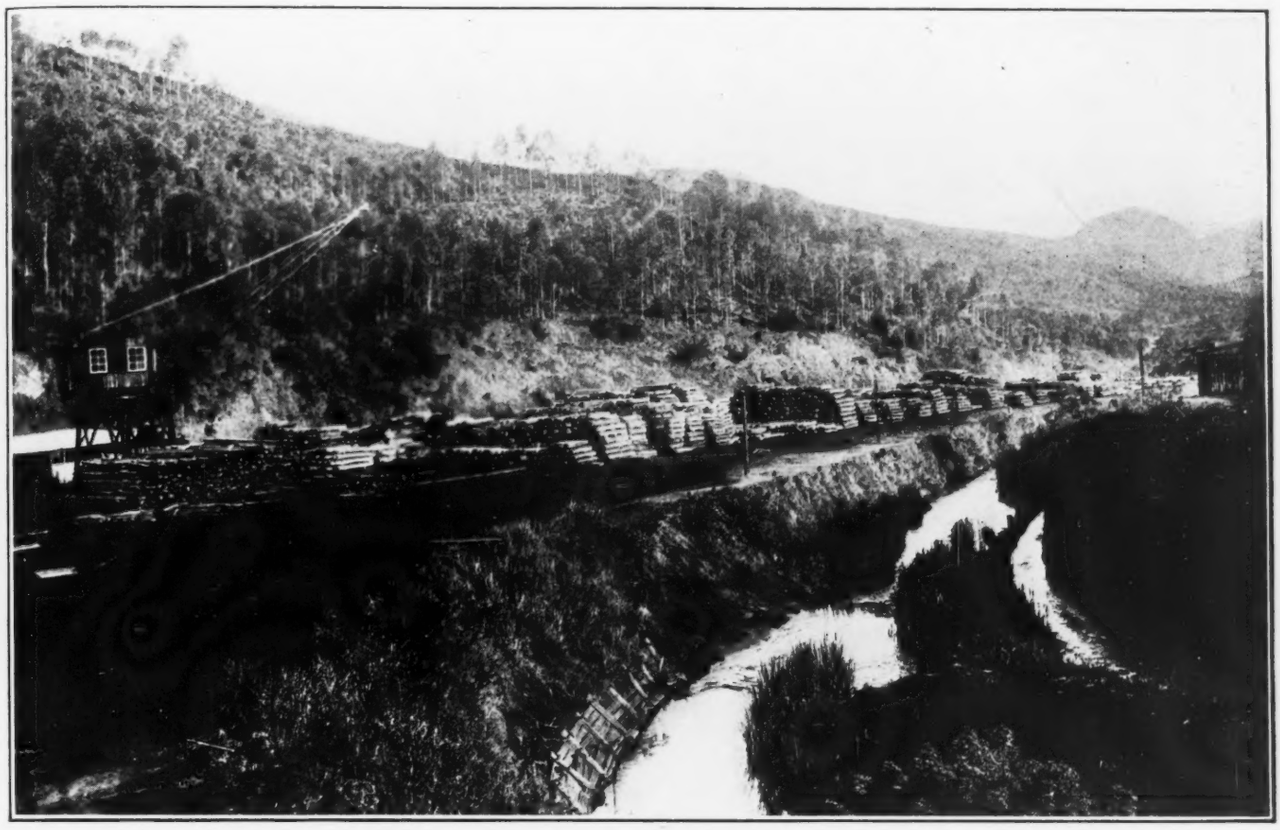


Stamp mill of the Ouro Preto Gold Mines, at Ouro Preto.

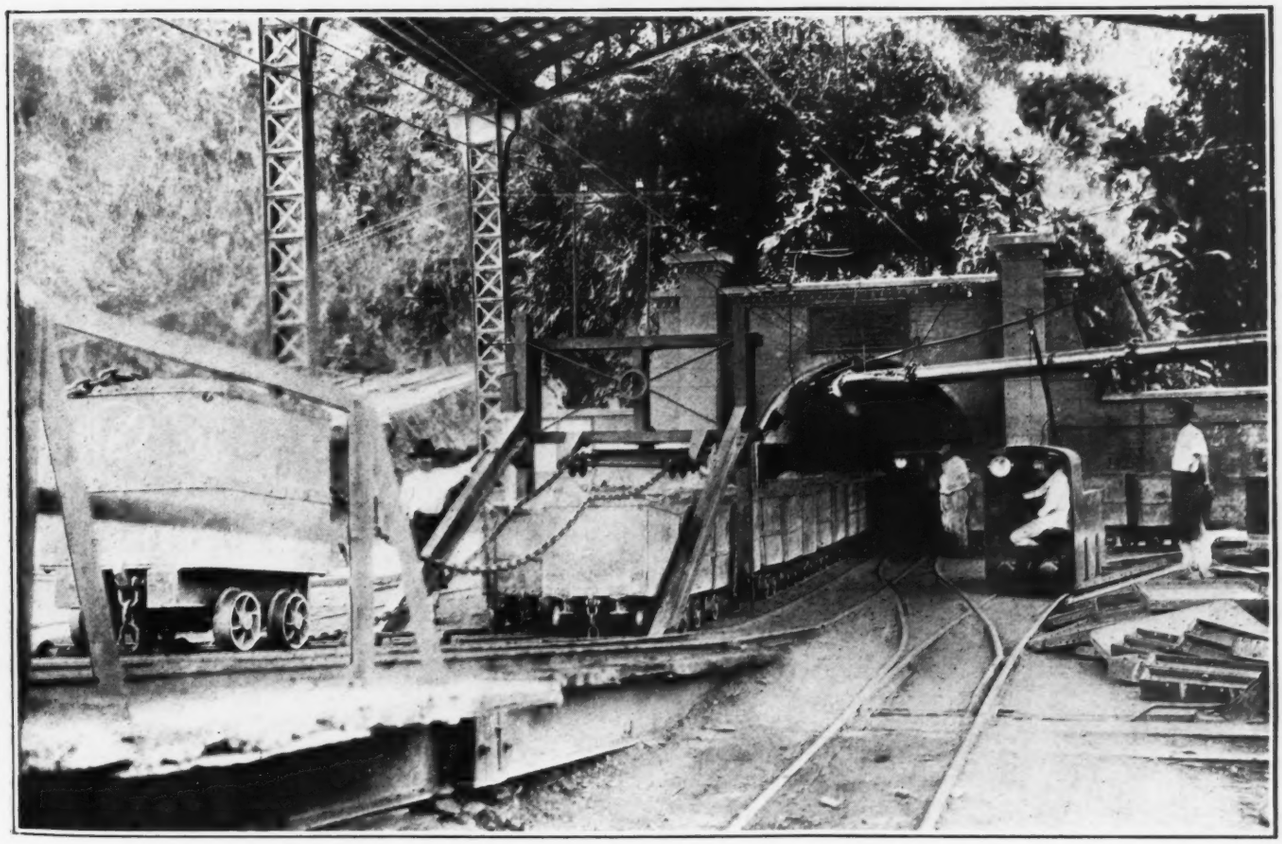


Underground in the Ouro Preto mine.

Dry masonry supports in the Ouro Preto mine.

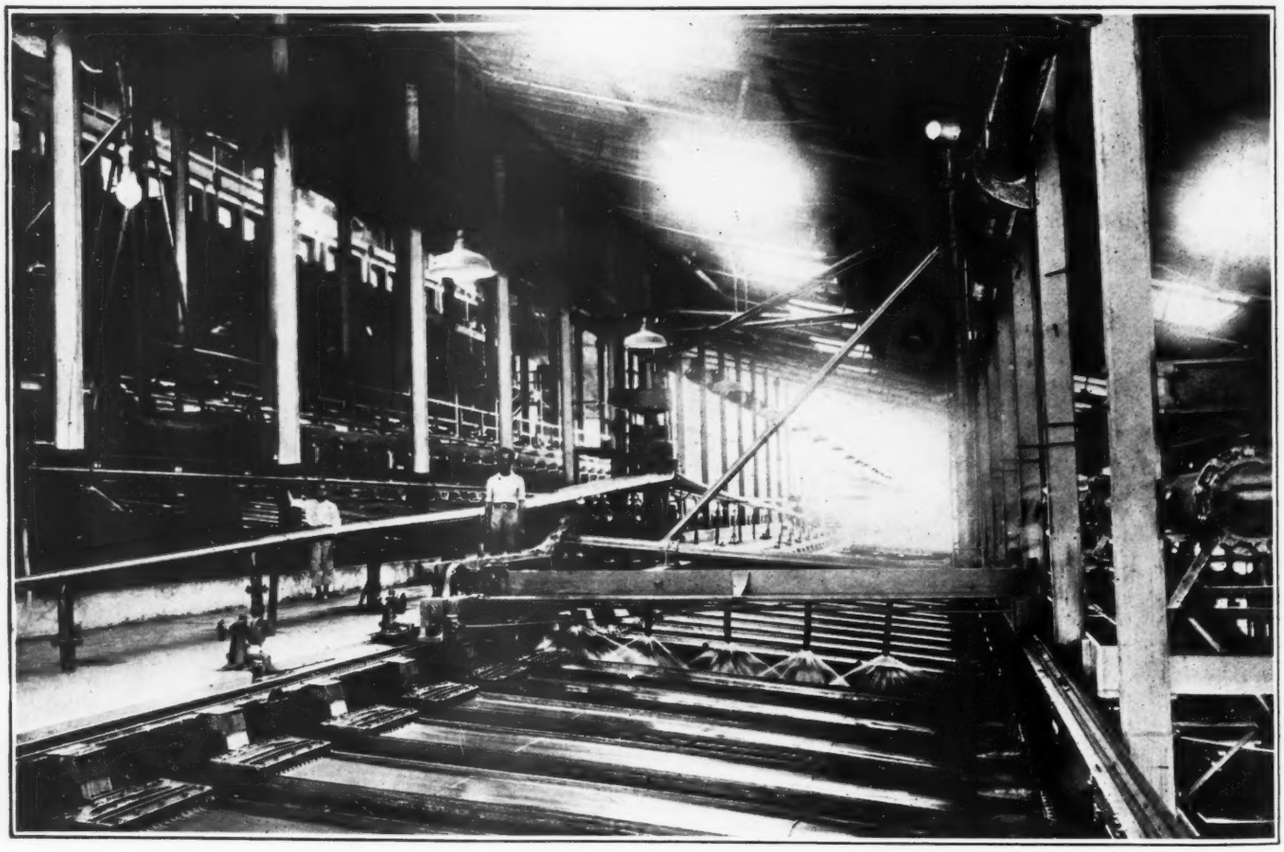


St. John del Rey timber yard. Good timber must be hauled from long distances.



Main adit of the St. John del Rey mine, showing electric haulage.

St. John del Rey's blacksmith shop is run by Brazilian workmen of the better class.



Automatic spraying washes concentrate from canvas tables at the St. John del Rey mill.

is actually collected, and, as Mr. Cleveland said, "it is a condition and not a theory" that confronts a mining company which plans operations which will take their products across state boundaries.

It seems to be an easy matter for any state government to increase the export tax, and I met in Rio a Brazilian, the solicitor for one of the government departments, who told me that he personally had developed a mica property in one of the states, but as soon as he got it developed to the point of production the state authorities imposed an export tax that wiped out all his hope of making a profit. Later on he found another small property and sold a small amount of the product at a profit, but again had a tax imposed that wiped out all his profit, whereupon he ceased attempting development of mineral properties. These export taxes are not inconsiderable. For example, the export tax on iron ore from Minas Geraes to Sao Paolo was originally about 75c. a ton. In this case the Brazilian company which planned to export the ore was able to get it reduced to a nominal figure, and though a foreign corporation perhaps might be equally successful—again, it might not.

Various Charges on Freight

Minor handicaps that might be mentioned in this connection are the unnecessary complications of business. Three examples will suffice: Manganese ore is shipped from Minas Geraes to Rio for export. Instead of the freight rate being a simple sum, easily comprehended, it is made up of four different items, respectively a transportation tax (as it is called), based on a theoretical computation of the value of the shipment and so reckoned that low-grade ores have to bear an unduly high rate; a tax on the use of cars; a tax supposed to be for the collection of the other two taxes; and a fourth tax which even those who pay it could not explain to me. Parcel post will serve as a second example. Many people in Rio told me that when anything was sent to them by parcel post they simply left it in the post office rather than attempt to go to the trouble and annoyance of getting it out. The receipt of parcel post in the interior is almost an impossibility. Regulations as to imports are very strict and so voluminous that it is extremely difficult to comply with them. For any infraction of the regulations an importer is fined. All these restrictions, which are small individually, bulk large in the sum total and are a decided deterrent to the transaction of business enterprises.

Geologic Conditions Not Propitious

A further important consideration is, it seems to me, that Brazil is a rather poor place to look for profitable mineral deposits, leaving out of consideration iron and manganese, the two minerals commonly found in ancient rocks. It is often said that Brazil is an unexplored country, but I was unable to get that impression from my own study of it. It is quite true that it has not been accurately mapped, but nevertheless it would appear that in the 400 years it has been known to the white man, people have been over pretty much all of the country. When I was there I was told of a party being organized to spend two or three years traveling through the interior hunting for mineral deposits, and I also met in Rio several people who were conducting development operations in a small way in various parts of the country. In other words, there are at all times a considerable number of persons who are hunting for mineral deposits in Brazil. It is true that ex-President Roosevelt and his party traveled through parts of the interior where a white man had apparently never been, but these are not regions where valuable mineral deposits seem likely to be found, because they are all regions of comparatively recent rocks, without, so far as known, the volcanic intrusions that are so characteristic of most mineral regions.

This leads up to a generalization that must be accepted with the reservations characteristic of any generalization. A large part of the area of Brazil consists of very ancient rocks, and a large part of the remainder of Tertiary sediments. The post-Paleozoic sediments are not found crumpled into mountains and cut by relatively recent eruptives in the way that is characteristic of the rich mineral deposits of North America and the West Coast of South America. Therefore, to my mind, it is a relatively poor place to look for rich mineral deposits, except the iron ores and manganese ores, which are commonly found in very old rocks. The gold deposits in Brazil are found in the region of ancient rocks, but the placer deposits have been pretty thoroughly worked out. Attempts to work gold lodes have, on the average, not been successful. It is true that some lode deposits were found that were very rich, but it generally proved impracticable to follow them to any considerable depth, with the two exceptions of the St. John del Rey and the Ouro Preto mines. Even these are not large mines, from the standpoint of tonnage.

Copper, Lead, and Silver Conspicuous by Absence

It is interesting to note that in the 400 years that exploration has been carried on in Brazil, no deposits of copper, lead, or silver have ever been found that have become the basis of even moderate-sized enterprises.

An important factor affecting the mining industry in Brazil is the efficiency of labor. In small-scale operations the low efficiency of Brazilian mine labor is not especially apparent, but in the case of large-scale enterprises, such as the St. John del Rey, it becomes of significance. That mining company, which produces about 550 tons of ore a day, has a total of between 3,000 and 4,000 employees. The average wage rate is low in Brazil. It is difficult to give any precise figures as to wage rates, because various bonuses are added for production, steadiness of work, and similar reasons. It will perhaps serve to make the point clear to state that a wage rate of 7 to 8 milreis a day, or, at the current rate of exchange, about a dollar gold, is the current rate for common labor. But even at a dollar a day Brazilian labor is not cheap, because it is inefficient.

There are a number of possible reasons why Brazilian labor is inefficient. Perhaps the most important of these is that, on the average, the population seems to be in poor health. One of the physicians of the Rockefeller Commission told me that in places 95 to 100 per cent of the rural population is infected with hookworm. Malaria is also common enough to be an economic problem. The doctor at one mine told me that a large number of the miners were infected with syphilis. There is doubtless much exaggeration, but even the official statistics of the Department of Public Health, shown at the Exposition in Rio, showed a high percentage of infection of all kinds of venereal diseases combined. Tuberculosis is prevalent in Brazil

and is much feared; it is promoted by the superstitious fear which the ordinary people have of night air. The continuous high temperature and humidity probably gives them low resistance, and the practice of a large number of persons sleeping in a single room, where the temperature is high and the air circulation is cut off, produces conditions that are favorable to the spread of tuberculosis, as well as the other diseases mentioned.

Natives Eat Much

A second reason for the low efficiency of the mine labor is, in my judgment, the workmen's habits of eating. While not an expert on dietetics, it appeared to me that the people, on the average, eat too much food, eat the wrong kinds of food, take it at the wrong time of day, and drink too little water. Judging simply from the general observations, I would estimate that the Brazilian people I came into contact with ate daily from two to three times as much food as I myself did. They eat a good deal of meat, it being their practice to eat it at least twice a day. There has been much discussion among dieticians as to the harmful effects of eating nitrogenous food in tropical climates. Aside from this, however, it is generally agreed that the eating of too much nitrogenous food produces harmful effects in any climate, with the result that both physical and mental energies are below par. Laborers eat little bread, getting their carbohydrates in the form of "farinha" or "mandioca." I doubt if these are as digestible or nutritious as bread.

The Brazilian custom of taking only a cup of coffee on getting up in the morning and postponing the first real meal of the day until 10 or 11 o'clock seems contrary to all experience in regard to the demands of manual laborers. Fitch, in his "Dietotherapy," refers to the taking of only a cup of coffee and a roll on getting up in the morning as "an absurd custom" for anybody to follow. It is generally agreed that manual workers should have a hearty breakfast, and if possible, a warm heavy meal in the middle of the day, with a light evening meal. In contrast to this, the Brazilian goes to work at 6 o'clock in the morning, having taken practically nothing but a cup of coffee, eats a heavy meal (with an excessive quantity of meat) out of a lunch box, and gets his heaviest meal in the evening.

Drink Too Little Water for a Hot Country

Finally, the practice of drinking water in minimum amounts is contrary to all general accepted ideas. In a warm climate, where sweating is profuse, it is generally necessary to drink water abundantly. Dr. Hunt has reported that Europeans in India, who are active outdoors, at a shade temperature of 115 deg. F. drank three gallons of water daily as a minimum amount. Brazilians drink very little water, probably because of the persistence of old habits developed in regions where water is not safe to drink. It is not difficult to secure pure drinking water in Brazil, however, so that the custom bears no present relation to environment. The coffee which they drink is taken very strong, so that a minimum amount of water is absorbed with it. The ordinary workman drinks, besides coffee, a native rum distilled from fermented molasses called by a variety of names, such as "paraty," "pinga," and "mate bichu." In the larger cities beer drinking has been introduced and is probably beneficial—if the people cannot be persuaded to drink water. The small amount of liquid taken is perhaps the explanation why so little benefit is apparently derived from such large quantities of food, since the amount of liquid present in the intestines is probably not sufficient for proper digestion.

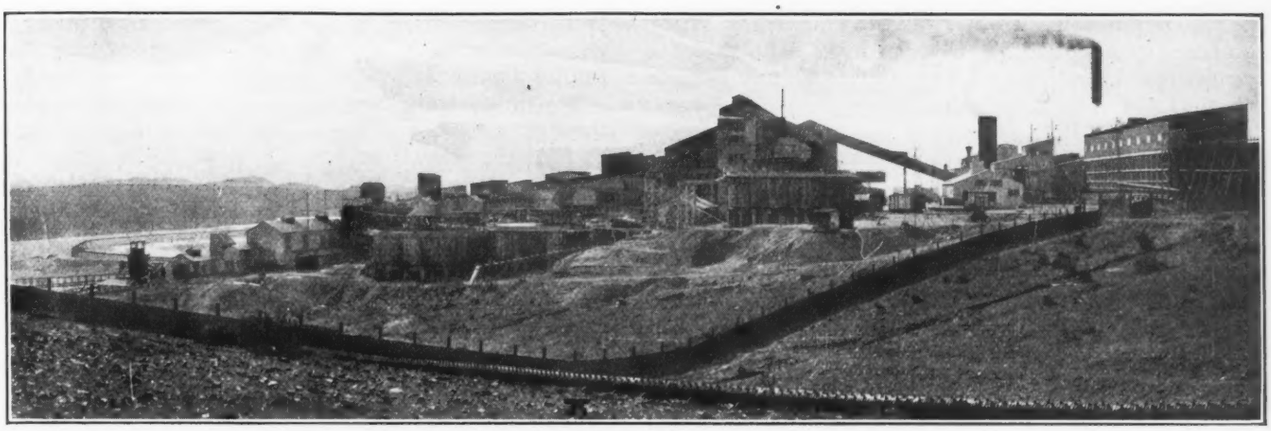
A third reason why Brazilian labor is inefficient may perhaps be the climate. The average temperature for the year at the St. John del Rey mine is 68 deg. F. The monthly averages for the year range from 61.7 to 72.4 deg. F. Comparing this climate with that of Norfolk, Va., which has an average temperature for the year of 60 deg. F., with a mean temperature for the coldest month of about 41 deg. F. and for the hottest 79 deg. F., it will be noticed that the average for the year at the St. John del Rey is 8 deg. above the average for the year at Norfolk. The mean of the hottest month at Norfolk is about 6 deg. hotter than at the St. John del Rey and the mean for the coldest month is about 20 deg. cooler. Those who have studied the relation of climate to physical and mental energy of the inhabitant have reached the conclusion that such a climate as that at the St. John del Rey is too warm for the yearly average, and, also, that it is too lacking in change. Experience seems to indicate that the frequent (and sometimes intense) variations in temperature and humidity that are experienced in the United States are actually decidedly stimulating to both physical and mental energies.

Negro Blood Does Not Make for Ambition

Finally, as to the workmen themselves: The only part of the United States to which I can compare the Minas Geraes region is the State of Mississippi, and there the analogy is not very close, because the white population is, of course, of a quite different stock from that in Mississippi. In Minas Geraes about 60 to 75 per cent of the people appear to have some negro blood. I cannot give any exact figures, because the Brazilians do not consider people negroes unless they are of absolutely pure negro stock; if they have any white blood in them they are reckoned as whites. From my own observation, and the observations of others, it is perhaps safe to say that 60 to 75 per cent of the people in the State of Minas Geraes would in this country be recorded in the census as negroes. They are not a virile or markedly industrious people.

In the light of the conditions just reviewed it does not seem surprising that Brazilian workmen are not more efficient, and that there is constant complaint of labor shortage. There is not really a labor shortage, because the number of men employed on a plant would be ample if the output per man were larger. It would appear that the proper line of progress should be directed toward trying to increase the efficiency of the workers rather than by trying to attract to the mines workmen who prefer the easier work of agricultural communities.

The author of this article spent three months during the latter part of 1922 in Brazil, where he went as a delegate to the International Engineering Exposition held at Rio de Janeiro. He spent part of his time in the states of Minas Geraes and São Paulo, where he obtained much of the information on which this article is based. He also conferred with officials of the Servicio Geologico in Rio. The excellent illustrations are from photographs obtained by Mr. Read from the officials of the St. John del Rey Mining Co. and from Arthur J. Bensusan, manager for the Ouro Preto Gold Mines of Brazil.—The Editor.



The concentrating plant of the Chino Copper Co.

The Chino Enterprise—V

Concentrating the Ore at Hurley and Smelting at El Paso

By T. A. Rickard

THE FIRST metallurgical operations at Santa Rita were performed by the Mexican owners of the mine, who used to melt the native copper before shipment to Chihuahua. Later they smelted the rich oxidized ore in little shaft furnaces, 8 ft. high and 18 in. in diameter; they were made of adobe, with an ash bottom, and were provided with a bellows. Some of these miniature blast furnaces were connected with a cupel or refining furnace. The fuel used was charcoal, made from juniper, oak, pine, and mahogany woods. One of the old Spanish molds for casting copper has been found. It was cut in rock and consisted of four recesses, 6x20 in. side by side. Twenty bricks of copper were found in a clump of willows on Whitewater Creek. These appear to have been dropped by somebody in flight, probably at the time when Santa Rita was evacuated hastily in fear of an Indian attack, soon after the Mimbres massacre.

Construction and Equipment of the Mill

The ore arrives at the mill in trains of twenty-eight railroad cars of fifty-ton nominal capacity but loaded to fifty-five tons each. They are 35 ft. long, and dump from the bottom. On arrival, the train is divided into sets of seven cars, one set for each of the three unloading tracks, so that twenty-one cars are in the ore house at the same time. The grizzly under the track is made of four lines of standard (60 lb. per yard) rail, with openings 12 in. square. The cross rails are placed upside down. The ore is discharged into two bins, one of 12,000 and one of 6,000 tons' capacity.

The mill building is a steel structure erected on concrete foundations.[1] It is housed with galvanized iron. All the floors are made of reinforced concrete. The building is divided into seven sections, each of which is 50 ft. wide by 341 ft. long.

The ore from the main bins is delivered by two single and one double "string" of twenty apron feeders in series onto three 34-in. belt conveyors that discharge upon a bar grizzly with ⅞-in. spaces, before delivery to two No. 8 McCully gyratory breakers, set to crush to 2½ in. The entire feed from each crusher goes to the boot of two elevators, which carry it to a ⅞-in. grizzly over rolls, the undersize joining the undersize from the crusher grizzly, the combined minus ⅞-in. product being then taken by two 36-in. belt conveyors to the fine-ore bins. The oversize goes through rolls, of which there are two sets, with 72x20-in. faces. From there the ore goes over another ⅞-in. impact screen, the undersize passing to the belt conveyor and the oversize to the elevator and so back to the rolls, thus completing the circuit.

The minus ⅞-in. stuff is raised by the inclined conveyors to the top of the mill, where all of it is sampled before being distributed to the fine-ore bins by means of three horizontal belt conveyors, two 26 in. and one 30 in., two traveling and one tripper. There are two fine-ore bins to each section, and seven sections in all. The normal capacity per fine-ore bin is 1,000 tons, with an available tonnage of 1,800.

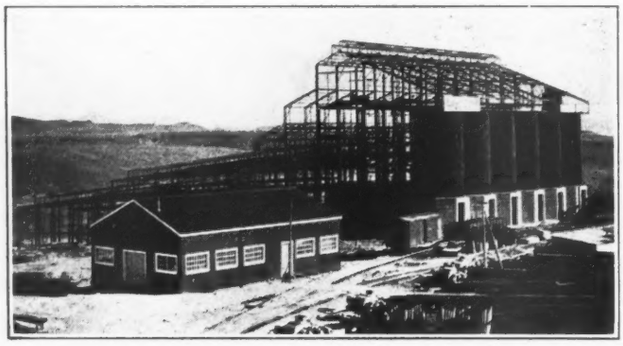
The fine-ore bins are cylindrical steel containers set on end; each section has two of them. I shall now describe one section, it being understood that the other six are identical in their design and equipment:

Handling the Crushed Ore

The ore is drawn from the two bins by four apron feeders, water being added in the proportion of 1.2 tons of water to 1 ton of ore. The moistened ore is then elevated by one 38-in. bucket elevator to eight impact screens of 8 mesh, or 0.⅞ in. The particles of ore, cleaned by wetting, appear on the screen in varied colors like a shivering mosaic of green, gray, and brown. One becomes conscious of the aromatic odor of the flotation oil, wafted hither from the lower floors of the mill. The oversize from the screens passes to two sets of 42x16-in. rolls, the product of which returns to the boot of the bucket elevator. The undersize from the impact screens is distributed by launder to twenty-two 4-ft. Garfield tables. These are of the Wilfley type, with extended riffles; they make a rough concentrate and a middling.

[1]See also "Milling the Ore of the Chino Mine," by John M. Sully. *Mining & Scientific Press*, March 30, 1912.

The rough concentrate is treated on eight Wilfley standard (6x14 ft.) tables, which make a finished concentrate and a middling. The middlings from both the Garfield and Wilfley tables are elevated by 8-in. Wilfley pumps to two Dorr classifiers having 15-ft. diameter bowls. The sand discharge is reground in three Chilean mills of 6-ft. diameter and two 7x10-ft. ball mills. The pulp from the Chilean mills is laundered to six Garfield tables, which make a rough concentrate and middling. The rough concentrate is treated on two standard Wilfley tables, which make a finished concentrate and a middling. The discharge from the ball mills is elevated by a 6-in. Wilfley pump to sixteen Garfield tables, which make a rough concentrate and a middling. The concentrate is treated on six standard Wilfley tables that make a finished concentrate and middling.



Concentrator building as it appeared when under construction in February, 1911.

The middling products from all the Garfield and Wilfley tables are elevated by 8-in. pumps, referred to above, to the Dorr bowl classifiers. The overflow from the Dorr classifiers is piped to a central distributor and distributed to the flotation units.

This completes the description of the upper part of the mill, except the disposal of the table concentrate, which is laundered to a 24-in. elevator and raised to two Dorr classifiers (Model C) equipped with vacuum trays and air jets. This dewatered concentrate is discharged into bins, from which it is taken by a gantry crane to the railroad cars, for shipment to the smelter at El Paso. The overflow from this dewatering classifier is mixed with the flotation concentrate and is again dewatered.

Some Magnetite Removed

At times when the proportion of magnetite in the ore is excessive, all the concentrate from the upper part of the mill is treated in three magnetic separators of the wet drum type, each with three drums. In these the excess of magnetite is removed, to be stored for future use in the making of sponge iron, concerning which I shall have more to say later. The copper concentrate from the magnetic separators goes to the dewatering classifiers, as usual.

Flotation by Janney Machines

In addition to the sampling of the mill feed, there are individual samplers for all the final tailings and the finished concentrates, all samplers being electrically operated.

We now come to the flotation department. On each unit the roughing operation is done on eight strings of modified Janney mechanical air-type flotation machines, each rougher string consisting of five 2 ft. 6 in. by 10 ft. air-cells and six Janney mechanical agitators equipped with individual vertical motors arranged in series, there being two mechanical agitators ahead of the first air-cell and one mechanical agitator ahead of each of the other four air-cells. The tailing from the last air-cell is rejected, whereas the concentrate from each string of roughing-cells is laundered to two cleaner-cells in series. The concentrate from the cleaner-cells is laundered to one re-cleaner cell of the same type, whereas the concentrate from the re-cleaner is a finished product. The tailings from the cleaner and re-cleaners are returned to the head of the roughers by means of a 6-in. Wilfley pump. The clean concentrate, plus the overflow from the gravity concentrate dewatering classifiers, is elevated by a 6-in. Wilfley pump, serving one and one-half units, to five 75x20 ft. and one 48x20 ft. Dorr thickeners, the thickened product from these being elevated by means of two inch Wilfley pumps to four 14x14 ft. drum-type Portland filters and two 14x14 ft. Oliver filters, on which the moisture in concentrate is reduced from 50 per cent to 20 per cent before delivery to bins, where it is mixed (by discharge) with the gravity concentrate,[2] containing only 8 per cent moisture, previous to being loaded into the railroad cars. The mixed concentrate as shipped contains 17 per cent water.

For most of my information and for his courtesy in explaining the methods used in the plant, I am indebted to J. T. Shimmin, the superintendent of the mill. The average recovery in the mill is 79 per cent.

In regard to flotation oils, reconstructed coal-tar, creosote, pine-oil, and sulphur are used.

Each of the seven sections of the mill was designed, as has been stated, to treat 1,000 tons per day, but the introduction of the flotation process in 1916, together with the additional equipment for fine grinding and tabling, resulted in doubling the capacity of the plant. The old process of concentration by means of water, for which the mill was designed originally, is known as the "gravity process," but the flotation process is not labeled the "levity process," as it well might be, for it depends upon the comparative lightness of the bubble-buoyed particles of mineral. The old method of concentration as first used in the Chino mill was identical with that used in the Utah Copper mills before they likewise were adapted to flotation. At those two plants the capacity was raised from 3,000 and 6,000 tons to 16,000 and 20,000 tons respectively by the adoption of the flotation method for treating the fine products from the concentrating tables.[3]

The operation of the Wilfley tables in the Chino mill is interesting to watch. The flakes of native copper can be seen moving amid the grains of black chalcocite. The classification on these concentrators produces successive bands of minerals; first, one of dark-red cuprite, then bright flakes of native copper, then the black chalcocite, with chalcopyrite and magnetite, and last the small bands of green-blue carbonates.

The character of the concentrate being produced by a flotation machine is tested by panning the black froth on a porcelain plaque, which shows the grains of purple

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[2]The concentrate produced by aid of classification and sizing in a medium of water is termed a gravity concentrate; on the other hand, the concentrate produced in a medium of water by means of froth in a medium of water might be termed a levity concentrate.

[3]"The Utah Copper Enterprise," by T. A. Rickard, *Min. & Scien. Press*, Nov. 30, 1918.

cuprite and black chalcocite, most of the native copper having been removed previously on the Wilfley tables.

In walking from the office to the Romero pit one sees several heaps of iron scrap, which, on examination, prove to be granulations or shot used for the purpose of chemical precipitation. Where this material now lies an experiment was made in leaching a pile of ore. Water from the pit was pumped into a launder in which any copper the water contained was precipitated on granulated iron and then the water was distributed over the ore pile, from which it drained through an old tunnel underneath into vats. The ledge below the tunnel at the base of the ore pile was provided with a concrete rim to check percolation into the pit. In the vats, which were coated with "P. & B." paint, the copper was precipitated on more of the granulated iron, after which the water, or impoverished solution, was pumped back to the ore pile and recirculated.

How the Sponge Iron Is Made

This experiment was sufficiently successful to suggest experimental work along similar lines at the mill. These latter experiments have been carefully checked, and they appear to be full of promise for the treatment of a small proportion of the ore. The main difficulty in treating ore containing copper carbonates and sulphide copper combined is to get an economical precipitant. The use of electrolysis is out of the question, on account of the high cost of electricity. Hydrogen sulphide and alkaline sulphides are too costly at a place so far from chemical establishments. Recent experiments have been based upon the use of sponge iron made in a muffle furnace. The raw material is the magnetite extracted from the mill concentrate by means of magnetic separators. This contains 60 per cent of iron; it is mixed with powdered bituminous coal from Gallup in the proportion of 3:1. This coal is crushed to ¼ in. and then retorted to reduce the volatile constituents to 15 per cent. The mixture is subjected to a temperature of 950 deg. C. for approximately twenty minutes in a muffle furnace, which has a revolving hearth and two fixed rabbles. Heat is applied by radiation through the walls of the seven carborundum tubes in which fuel oil is burned. These tubes have walls 1 in. thick and their internal diameter is 8 in. The furnace is 12 ft. in diameter and has a capacity of three and one-half tons of sponge iron per day.

The idea is to treat the mixed sulphide and carbonate ore on one section of the mill independent of the other mill sections, and thicken the overflow of the Door bowl classifiers, which will be sized to minus 65 mesh on Dorr machines to a consistence of 2½:1. The thickened pulp will pass to a Dorr agitator, where acid sufficient to dissolve the copper will be added. The time needed for solution is estimated at thirty minutes. The sponge iron will be added in the proportion required to complete the precipitation of the copper. The precipitation will be at the rate of 0.85 lb. of copper per pound of sponge iron. The Dorr agitators will be three in series. The acid comes from the Calumet & Arizona company's smelter at Douglas. When precipitation is completed an addition of pulverized limestone will be made, first to neutralize any surviving free acid and then to precipitate any ferric iron. The residue from the agitator vat will go to one standard flotation section.

A beautiful illustration of the underlying chemistry of this process is obtained by taking some oxidized ore containing 2 per cent of copper (1 per cent in carbonate form and 1 per cent in sulphide form) and grinding the ore to 65 mesh. The pulp is placed in a glass jar of two liters' capacity, and to it is added 10 gr. of acid; then follows agitation for half an hour, after which the sponge iron is added, with the precipitation of the copper in the pulp. Limestone is added, and then the pulp is passed through a small flotation machine, which yields a handsome slime concentrate of red copper.

Shortly before my visit, Percy R. Middleton, an Australian metallurgist, had been conducting sundry interesting experiments based on the idea of roasting the ore at a temperature so controlled as to yield a maximum proportion of water-soluble copper sulphate,[4] but the Chino ore does not contain enough sulphur to render such a method feasible.

Foundations for the ore bins at the mill.

Copper Precipitated From Drainage Water

Another phase of the leaching process is presented at the mine by the winning of copper from the drainage of the open workings—the "pit." When I stood on the big dump of waste, representing the stripping and other rock too poor to be treated as ore, I looked down from a height of 125 ft. upon the gully through which runs Whitewater Creek. The blue of the sky was reflected in the clear water, which was fringed by a band of green copper salts. Two hundred yards from the big dump was a dam from which the water that comes through the dump is led to launders in which the copper is precipitated on scrap iron. The flow of water varies from 15 to 1,500 gal. per minute. Copper is

[4] "Sulphatizing Roasting of Semi-Oxidized Copper Ores," by Percy R. Middleton. *Engineering and Mining Journal-Press*, April 15, 1922.

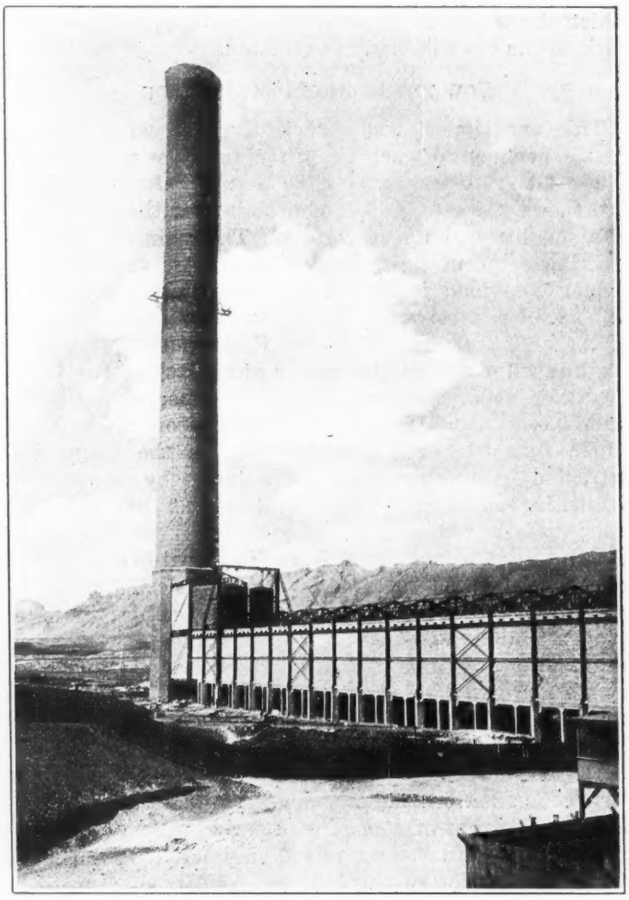
recovered at the rate of 2 to 8 lb. per 1,000 gal. The creek bed appears to serve as a rocky pavement offering little opportunity for leakage. It is proposed to pump the pit water, after acidifying, over the dump. There is a suggestion in this of a time coming when old dumps will be leached in the open on a big scale by means of waste water that has been slightly acidified.

From F. E. Thurber (Michigan E. M., 1912), who has charge of the precipitation plant, I obtained sundry interesting data. On May 18, 1922, the record showed a flow of 10 gal. per minute, or 14,400 gal. for the day. The assay of the pit water yielded 1.3 lb. copper per 1,000 gal. The assay of the water in the launders showed 1.34 lb. of copper, because the water dissolves some of the copper previously precipitated in the length (150 ft.) of launder between the inlet and the branch launder in which the acid is added. The tailing, or effluent, water assayed 0.12 lb. copper per 1,000 gal. The water in the launder is slightly acid—0.8 lb. of acid per 1,000 gal. The tailing water carries iron—2.0 lb. ferrous and 0.6 ferric per 1,000 gal. The total recovery of copper for the day was 15 lb. precipitated, or 1.8 lb. per 1,000 gal., or 1.5 lb. per pound of acid. A total of 10 lb. of acid was added during the day, or 0.7 lb. per 1,000 gal., or 0.6 lb. per pound of copper. The iron ratio (ferrous: copper precipitated) was 1.69, and the ferric ratio was 0.51. The extraction was 91 per cent.

Since Oct. 26, 1921, to the date of my visit—seven months—a total of 45,189 lb. of copper had been won from the pit water. There had been treated 14,505,300 gal. of water and there had been pumped onto the dump 10,529,500 gal. of water; therefore the natural drainage into the creek had contributed 3,975,800 gal. To the water had been added 10,253 lb. of acid of 58 per cent strength. Pumping of water from the pit ceased on April 7, 1922. While pumping, the results were better; for example, on Feb. 23 the flow of water was 80 gal. per minute and the total for the day 115,200 gal. The assay of the influent water was 5.68 lb. copper per 1,000 gal. and the assay of the effluent water was 1.48 lb., whereas the launder assay yielded 4.88 lb. copper per 1,000 gal. The acidity of the launder water was 0.62. At the discharge the ferrous iron was 8.74 lb.; the ferric iron in the launder was 0.48 lb. and at the discharge 1.40 lb. per 1,000 gal. The ferrous ratio in the effluent water was 1.46 and the ferric 0.21. The extraction of copper on that day was 599 lb., or 5.2 lb. per 1,000 gal., or 8 lb. per pound of acid added. The quantity of acid added was 74 lb., or 0.65 lb. per 1,000 gal., or 0.13 lb. per pound of copper. The extraction was 93 per cent. The quantity of water pumped onto the dump was 99,000 gal., or 165 gal. per pound of copper recovered. On that day the record showed 23,866 lb. total copper recovered to date, after treating 8,726,840 gal. of water, of which 6,554,300 gal. had been pumped onto the dump. The total acid added had been 1,572 lb.

The use of iron scrap of various kinds gives a characteristically untidy appearance to the leaching operation and it involves trouble in removal of the precipitate. I remember that the copper-leaching plant[5] at the Utah Copper mill gave the same impression. In the launder of the Chino plant I picked up an old shovel, crumbling and corroded, and covered with a granular precipitate of metallic copper. At the outlet from the dam, where a Bristol recorder serves to measure the flow, I saw an old bolt almost completely replaced by a beautiful crystalline deposit of copper. In the upper launder—above the point where the acid is added—the iron is almost completely replaced by copper. A green fungoid growth is observed; it seems out of place; one would not expect it in water containing acid. In the launder through which the effluent water runs the copper precipitate is coated with a film of ferrous iron. It is intended to reconstruct this precipitation plant and to use sponge iron instead of scrap. This will decrease the amount of labor needed to collect the precipitated copper, because the proportion of iron can be adjusted to the quantity of copper to be precipitated.

From Santa Rita I went to El Paso to see the smelting of the concentrate from the Chino mill. The distance by rail is 140 miles, over the Santa Fe and Southern Pacific tracks.



Flue system and 400-ft. stack at the El Paso smelter.

The El Paso smelter was started in 1883 to treat lead ores, and its principal business was in that department of metallurgy for many years. In 1910 the owners of the smelter, the American Smelting & Refining Co., built a copper plant for the purpose of treating Chino concentrate, as a basis of operations, together with miscellaneous ores and concentrates of copper from all over the Southwest. The Chino concentrate supplies the bulk of the iron and sulphur necessary to combine with miscellaneous oxidized ores, most of which are of a siliceous nature. Owing to the varying character of the different orebodies at Santa Rita, and to variations in the milling practice from time to time, there have been violent fluctuations in

[5]Described in *Mining & Scientific Press* of Dec. 14, 1918. "The Utah Copper Enterprise," Part VIII.

the iron and sulphur contents of the concentrate, causing undesirable smelting conditions. While I was at Santa Rita H. A. Eye, assistant general manager of the smelter, was there to induce Mr. Sully to send a more uniform product. Occasional lots of raw (unconcentrated) siliceous ore are shipped to the smelter from the Chino mine for use as converter flux. This product assays 3 to 4 per cent copper, and contains 50 per cent or more of silica.

After the Chino mill started (in 1909), and for five years thereafter, the flotation concentrate was kept separate from the table concentrate, so that it contained an excessive proportion of water—about 20 per cent. "It made an awful lot of trouble," said R. C.

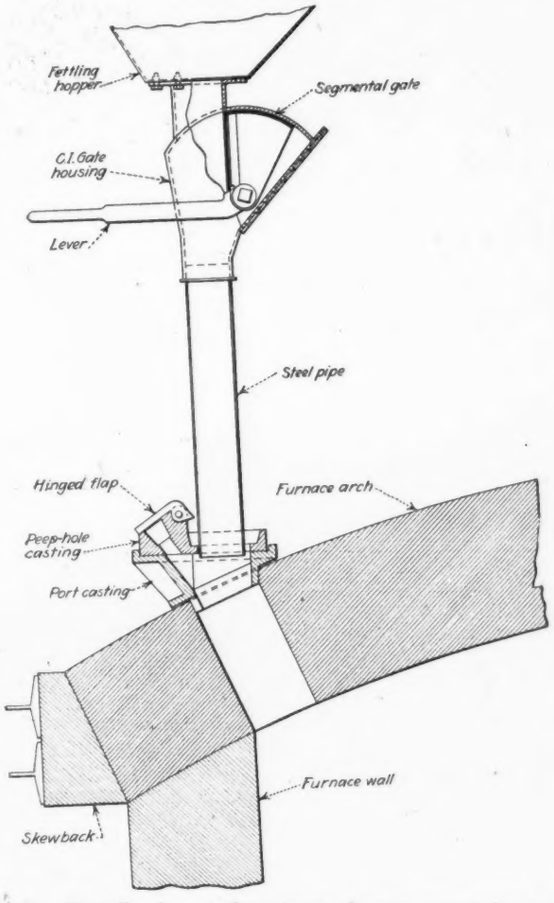


Fig. 1—Detail of reverberatory charge spout in use at the El Paso smelting works.

Stryker (Carnegie Institute of Technology), assistant superintendent, who was kind enough to pilot me through the plant. Some of the carloads of this flotation concentrate arrived with water a foot deep on top. This was drained by aid of a hose, and then the carload was allowed to stand in the yard exposed to the warm air—and there is plenty of warmth at El Paso during most of the year. The concentrate as it arrives by train is shoveled from the cars into hoppers under which travels a belt, 36 in. wide, that discharges into bins. Of these there are four, each holding 2,000 tons. A crew of four men per railroad car does the work. A car containing fifty tons is emptied in a few hours. Every tenth shovel is taken as a control sample, which, until the car is partly emptied, is thrown upon boards placed on top of the load that is being shoveled. Then the car, containing only the sample, is pushed downgrade to holes at the rear of the unloading platform, the sample is dropped, and waits there until five carload samples—weighing therefore about twenty-five tons altogether—have been assembled. The siliceous ore from the Chino mine is crushed to half an inch, conveyed by belt, and discharged by a tripper into the bins.

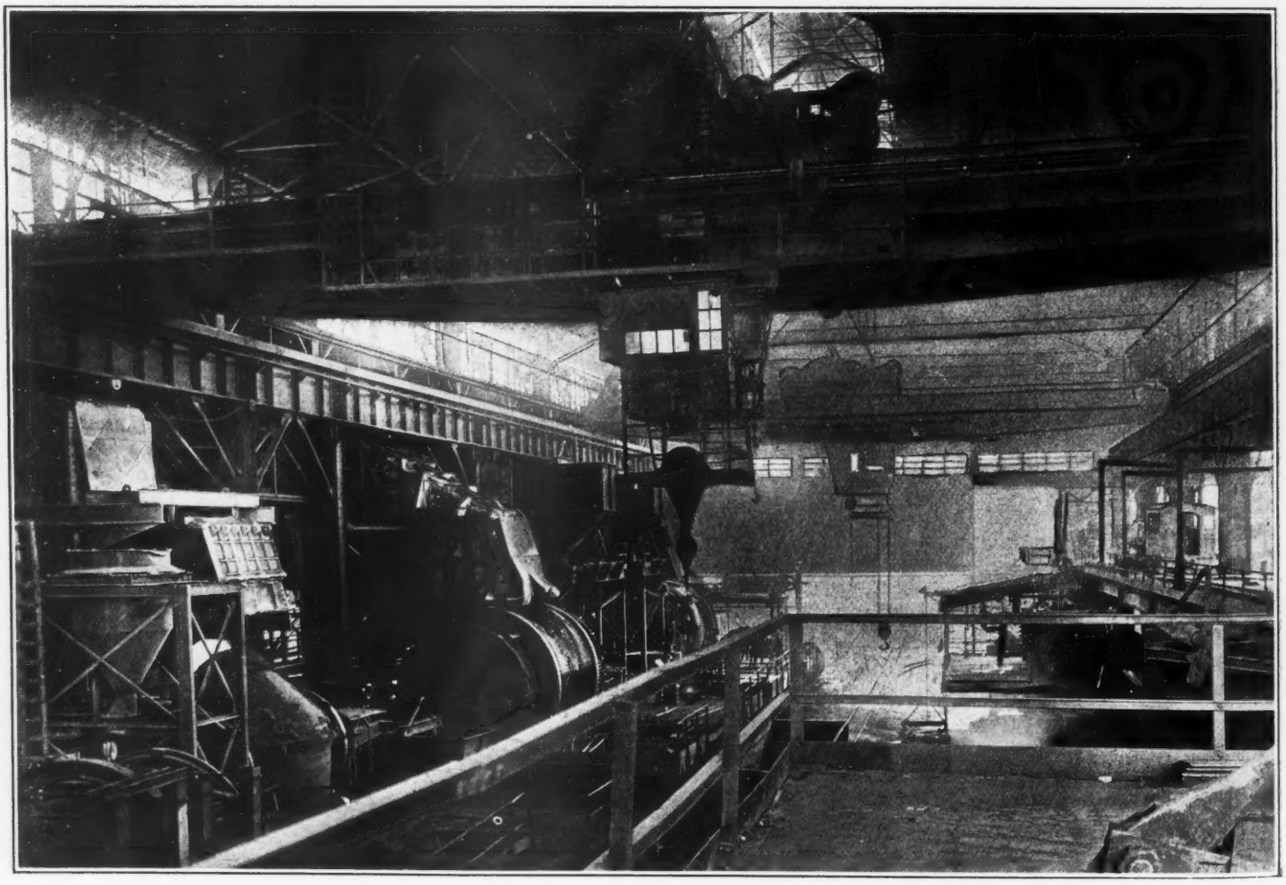
The concentrate now received from Santa Rita is a mixture of the flotation product with the yield from the Wilfley tables and vanners. It carries 15 per cent of water, and is more than wet enough from the smelterman's point of view. It is distributed by a traveling tripper into the four bins, so as to make a nearly uniform mixture with the other ingredients of the charge. Lime is obtained from a quarry only a mile distant, as no ore with an excess of lime is received at the smelter. The discharge from the bins has to be aided by raking, because the material sticks to the sides of the bin. It falls upon a 36-in. belt conveyor through a hopper provided with an opening that runs lengthwise with the belt.

The construction of the big bins was stopped by the Armistice, in 1918, because that event synchronized with a sudden decrease in the demand for copper. The bins are not yet complete. The copper smelting plant that I shall describe had been idle since May, 1921—that is, for twelve months preceding the date of my visit, on May 27, 1922. Fires were to be started in the furnaces the next day.

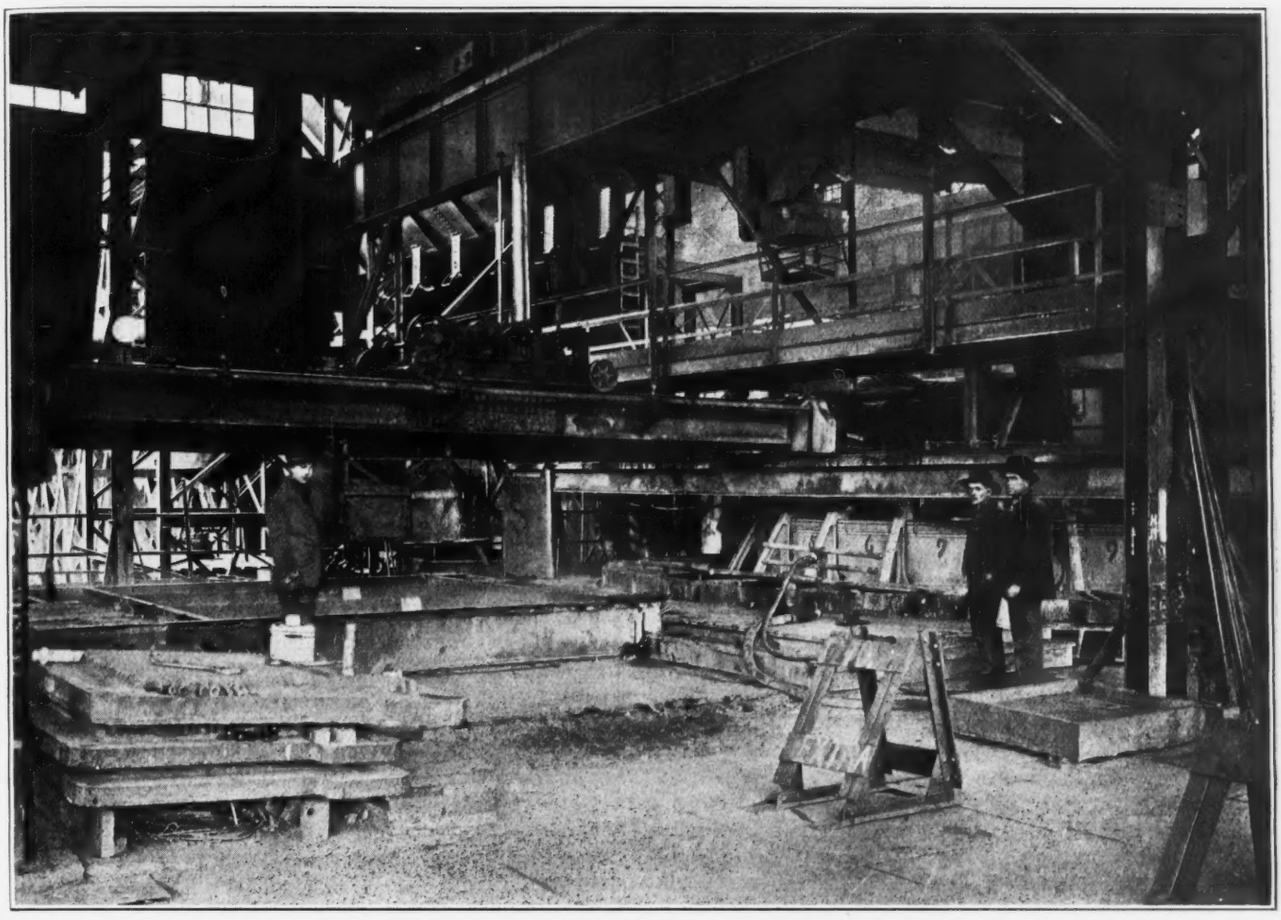
The roasting plant consists of twelve furnaces, all of the Wedge type, eight with five hearths and four with seven hearths. The seven-hearth furnaces have air-cooled rabbles; of the five-hearth furnaces four have water-cooled rabbles, the others being air-cooled. All the furnaces are fired by oil burners, because the amount of sulphur in the concentrate is not enough to dispense with this auxiliary heat. Four to five gallons of oil is used per ton. The conveyor from the bins discharges into a hopper of eighty-five tons' capacity placed over each seven-hearth roaster; the smaller roasters are provided with forty-ton hoppers. From the hopper the concentrate is fed by a drum to the uppermost hearth, and from the lowest hearth it is discharged by the rabbles into two hoppers—one on each side—into a car that holds two tons. From each big furnace 120 tons of roasted ore (for the concentrate is "ore" to the metallurgist) is drawn daily. A sample, to ascertain the sulphur content, is taken from the top hearth and another is taken of the "calcine," or roasted product. The aim is to keep as much sulphur as possible in the roasted product consistent with at least a temperature of 850 deg. F. Thus the "roasting" operation is not designed to expel all the sulphur, which is needed to make the matte, but to change the mechanical condition of the ore from a wet slime into a dry, hot product, intimately mixed.

From a floor of the roaster building one obtains a good view of the surrounding country across the valley of the Rio Grande, which, as far north as El Paso, serves as the boundary between the United States and Mexico. On the flat outside the smelter a cluster of adobe houses marks the homes of the Mexican employees of the company. On the opposite side of the river are barren hills, at the base of which, near the river bank, are houses occupied by the employees of the El Paso Brick Co., and to the left is a monument, a stone pillar, that marks the meeting of the boundaries of Texas and Mexico. Fifty feet from the monument is the

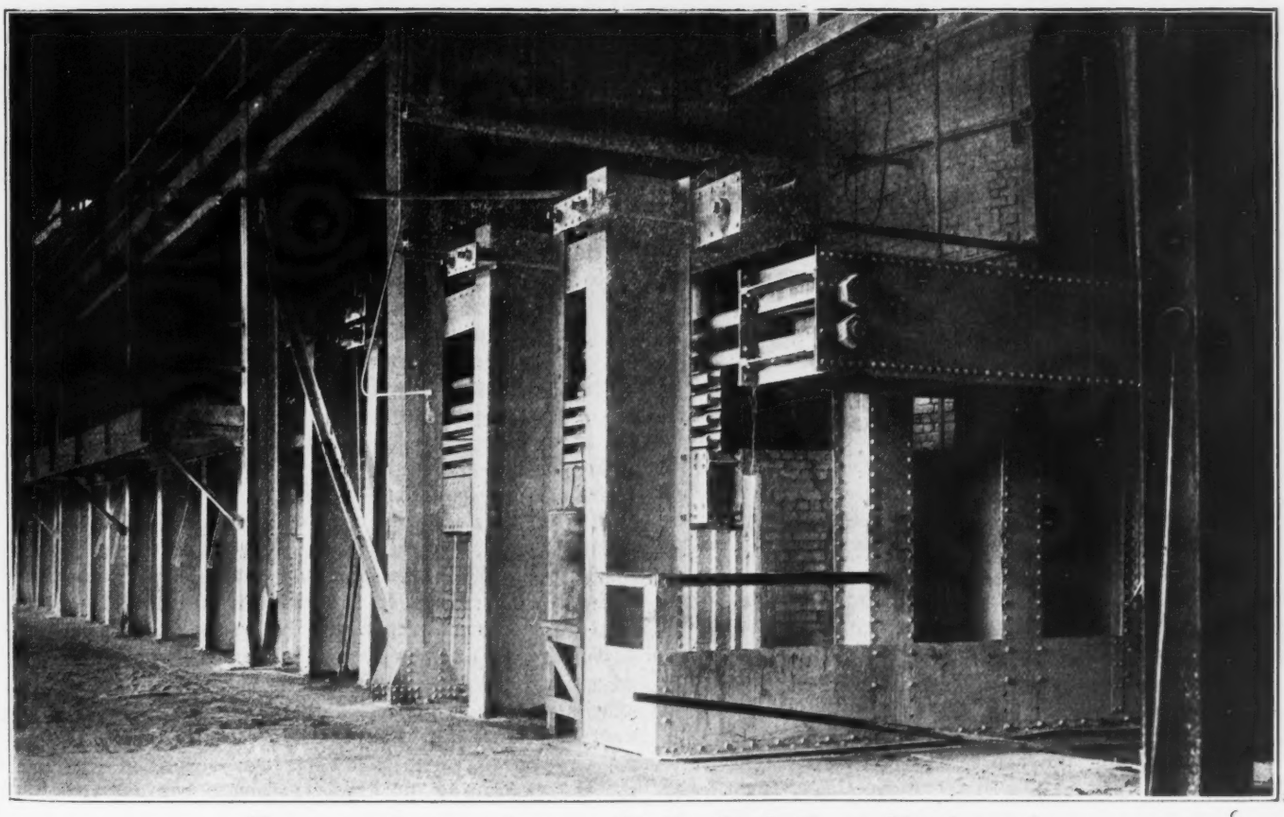
Copper department of the El Paso smelter, showing crane aisle and firing end of reverberatories.



Converter section, the backs of the reverberatories being at the right of the aisle.



Casting department, showing crane for handling anodes.



No. 4 reverberatory furnace, showing the front, or skimming, end.

little brown adobe house that was occupied by Madero when he started his revolution in 1910. In an arroyo south of this, Orosco and his army had their headquarters, and in another, Villa and his men were camped. Orosco was shot for a political offense; Madero was assassinated when President of Mexico; and Villa has recently met a violent death. The story of Mexican reformation is written in red.

To return to business: The car of roasted ore is weighed before delivery to the reverberatory furnace. The car cover fits closely against the hopper through which it is loaded from the roaster, so as to prevent escape of dust, or "prevent dusting," as they say. Two cars at a time are hauled by a Jeffrey electric motor to the reverberatory furnace, where they discharge from both sides by means of a half-arc gate on the bottom, operated by a lever. The calcine is discharged onto a grill, with 5-in. square openings, which is meant to arrest bricks and other foreign material. The grill is above hoppers of various sizes, made to conform with the steel structure of the building. The reverberatory furnaces are four in number, varying from 19 to 28 ft. in width and 100 to 120 ft. in length. From the hoppers, which run about two-thirds the length of the furnace and on both sides, the calcine falls through spouts (twenty on each side) into the furnace. The hopper is dust-proof; likewise the spouts (Fig. 1), at the discharge into the furnace, are made as nearly dust-proof as possible, and are calked with asbestos to prevent burning through. The gate is an arch, and is considered the best of its kind. It was invented by James Phipps. Oil is used as fuel. It is heated to 210 deg. F. before use, and atomized with air at a pressure of 13 lb. from the compressor that supplies the converters. Each reverberatory has eight oil burners.

Molten Slag Poured in Reverberatories

Slag from the converters is fed molten to the reverberatory furnaces by means of a ladle, which discharges into a hopper of 8 ft. diameter provided with a double-rail grill, to stop the shell if it should fall from the ladle. The slag passes into the reverberatory furnace through an opening that consists of a pipe of 24 in. diameter, provided with a water-cooled jacket, in the arch of the roof.

Matte from the reverberatory furnaces is tapped into a cast-iron launder 75 ft. long. The matte contains 40 to 50 per cent of copper, depending upon the amount of sulphur available. The slag issues through a slot, 10 in. high and 4 in. horizontal, which is raised or lowered in accordance with the quantity of matte in the furnace. No "blanket" of siliceous scum is skimmed, because it is rich enough (1 per cent copper) to be left in the furnace. The slag discharges through a cast-iron launder into pots of six tons' capacity. These are pulled, three at a time, by a steam locomotive, to the dump. The draft in the reverberatory is maintained at as low a pressure as possible without making too much smoke at the waste-heat boilers. The pressure is about 0.10 to 0.12 in. on the gage. It is the superintendent's aim to keep the furnaces just as nearly air-tight as is practicable, and to that end all holes and expansion joints are kept filled by means of "chinking" with clay.

The matte runs through the launder into ladles that hold sixteen tons and are carried by an electric crane to the converters, of which there are three, two of the Peirce-Smith or horizontal cylinder type and one of the Great Falls or vertical barrel type. The Peirce-Smith converters have a daily capacity of 100 to 120 tons of blister copper; the Great Falls converter has a capacity of fifty to seventy-five tons only. Silica is added to these converters from cars that discharge into eighty-ton hoppers. The siliceous constituent is fed while blowing the matte; it is introduced into the horizontal converters by means of an air jet, which is inserted far enough into a feeding tube to suck the silica and then blow it over the bath of molten metal in the converter. The device is known as the Garr gun, after the name of the inventor.

The blister copper is poured into a slag-lined ladle that holds twenty-five tons. The ladle is carried by a crane to the anode furnace, into which the copper is poured through a receiving spout, which holds 180 tons. There it is maintained in a molten condition while it is being cleansed by aid of air that is blown into it, to oxidize impurities, and then by means of stirring by green poles, which remove the oxygen by reduction. The slag, in which form the impurities, rises to the surface and is skimmed at intervals. The poling is done through the slag port. The anode furnaces—of which there are two—are of the tilting type. The purified copper flows into a spoon lined with cement that feeds the Walker wheel, a circular traveling mold, which yields twenty-two anode plates, ready to be hung in the electrolytic cells of the refinery.

A Whiting crane picks up the anodes by means of lugs on the side of each plate. They are dropped into a water tank to be cooled, and are then lifted by a fifteen-ton Shaw crane to be loaded on the railroad cars for shipment to Baltimore, where the refinery is situated. The anode plates contain 99.7 to 99.8 per cent of copper. They are marketable for casting copper, but the silver and gold in them renders them too valuable for that purpose. They are made in two sizes, one weighing 950 to 980 lb., used for starting plates, and another weighing 750 to 800 lb., which is the regular anode plate. During the war seven cars each containing forty tons of copper were shipped in one day. All skilled work is done by white men, only the common labor being performed by Mexicans.

During my visit to Santa Rita I asked myself many times what a Spanish *caballero* of the eighteenth century, if he had revisited the scene of his former activities, would have thought of the Chino company's operations. The steam shovel and its almost human manipulations would have astonished him; likewise a train or an automobile. The use of electricity as motive power and the lighting of the mine by night would have excited his wonder. But if we share with Mr. Sully a certain feeling of superiority over the Spanish gentleman of a bygone day, what mental attitude shall we take toward the visitor of a century hence? He, I think, would be surprised at the inadequacy of our methods of transportation. He would consider our roads—such a road as the one that connects Santa Rita with the mill and the railroad—atrociously bad when viewed with regard to the cost of the motor vehicles that go over it and the traffic that it bears. In that day a century ahead it is likely that some convenient form of storage battery will be in general use, or perhaps power will be transmitted by a radio system from a central station on the Colorado River! *Quien sabe?* So we leave the surmise uncertain whether the *caballero* of the beginning of the nineteenth century or the *gringo* of 2023 A.D. will be the more surprised—and humbled.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Association of Ores and Dikes

THE EDITOR:

Sir—In an editorial "The Value of a 'Contact,'" in your Nov. 29 issue you state there is no direct relation between the mass of the parent intrusion and the mass of associated ores. From my observation not only is this true, but the reverse is true. That is, the small dikes are the best mineralizers. In a letter of mine published in the Oct. 13 issue of the *Journal-Press* I spoke of a small green dike intersecting a quartz and iron pyrite vein which in some manner had caused copper ore to be formed at that point. After seeing this occurrence of copper I made it a point to look up almost every copper occurrence in the district (Copper Creek district, western part of Yavapai County, Ariz.), and found most of them associated with narrow green dikes. Some of the dikes were so small that unless I had seen the effect of the small dike in the bottom of Copper Creek I should have passed them up as being without any influence. In every district I have been in since, I have noticed the frequent association of copper and narrow green dikes. Many of the specimens of copper ore in the Yavapai Chamber of Commerce, at Prescott, are in the form of a copper sulphide in black-green schist.

I have noticed the same association between narrow dikes and tungsten. In the Camp Wood tungsten district, Yavapai County, the tungsten is in nearly every case associated with narrow pegmatite dikes. None is associated with the larger pegmatite dikes. In the same district, along the border of narrow dikes and sills of a fine-grained pegmatite in the schist, is often found a great deal of fluorite, but none is found along the bigger dikes or masses.

I have often wondered about this association between mineralization and narrow dikes. Your theory that the common association of dikes and veins is due to the fact that both are derived from a common deeper source seems to explain it. If the ore magma was more fluid and not so easily solidified as the rock magma, it would naturally be forced to concentrate in the upper part. As the narrow part of a dike is its upper part, this would cause a concentration of ore magma in the narrow upper part of a dike. It would start solidifying from the bottom up.

Prescott, Ariz. WILLIAM CROCKER.

THE EDITOR:

Sir—After forty years prospecting, mine hunting, etc., in many parts of the world, your editorial "The Value of a Contact" impressed me very much as being the only concise and indisputable article on the subject—more especially the part relating to dikes and veins—that I have ever read, and one that I hope many geologists and mining experts will digest for the benefit of their future employers. You most certainly have in a few words diagnosed a most important subject which others have written volumes about, and left the reader no wiser. AN OLD PROSPECTOR.

Mazatlan, Sinaloa.

Summarizing Mining Reports

THE EDITOR:

Sir—I have read with interest, in the Dec. 15 issue of the *Journal-Press*, a discussion by L. C. Stuckey, of Bilbao, Spain, of my article on Oct. 27 entitled "An Analytical Method of Summarizing Mining Reports." Mr. Stuckey cites the figures (Table A) that appeared on page 714, in the summary of production, and notes that the profit per ton on ore of $17.20 grade is given as $1.71, but that "total production costs are given as $14.39," thus introducing an error of $1.10. In reply, I would like to point out the fact that the figure of $14.39 is distinctly *not* given as a total production cost for ore worth $17.20, but is set forth as "Total Production Cost for Critical Value"—that is, for ore worth $14.39, which is the estimated critical value for 100 tons' daily capacity. Table A shows how this is made up. Now, for ore worth $17.20, marketing costs (including milling losses) come to $1.10 per ton more than for ore of critical value ($14.39), and, therefore, the estimated profit of $1.71 per ton on all ore available above critical value is correct as originally given in my article. Mr. Stuckey's criticism is valuable, nevertheless, because it indicates that there is lack of clarity in the captions for the items discussed, which was not suspected by me when the article went to press.

Mr. Stuckey also questions the wisdom of including milling losses under cost of marketing, in one lump sum. I would concur entirely if no other cognizance was taken of this important matter. We are, however, dealing with a summary, and the body of the report would contain a detailed discussion of this matter. It would also be touched upon briefly in the one or two pages of typed matter in the Letter of Transmittal, so that the client would be fully informed before studying the tables given on page 714. Similarly, the client would be informed in advance as to the basis, scope, and limitations of all estimates, to guard against his putting a false value on the tables in the summary. All these points were carefully and explicitly taken up and discussed by me in the introductory paragraphs of my article, to which Mr. Stuckey is referred. However, I think that the set-up of Table A would be improved by segregating metallurgical losses—perhaps in a footnote would be sufficient, and I am indebted to Mr. Stuckey for the suggestion.

May I now call attention, Mr. Editor, to one or two errors that appeared in my article, as presented on Oct. 27? On page 714, in Table C, the average value

of all Indicated Ore available for the operation of a plant of 500 tons' daily capacity is given as $0.42. It should read $9.42. The last sentence of the short paragraph immediately below the graph on page 716 should read: "This proves later on to be the case and therefore its general equation is expressed by" (etc.). Equations J and K, at the bottom of page 717 are incorrect because the radicle includes only one number, whereas there are two numbers in the expression under the square root sign. These equations should read:

(J) $P = + \sqrt{38.76(V) + 498.48} - 28.72$

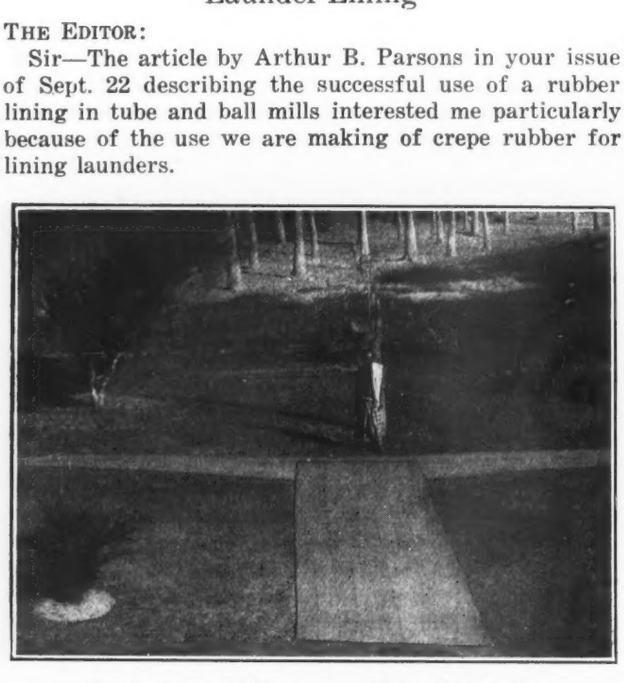
(K) $P = + \sqrt{40.161(V) + 560.392} - 29.061$

Philadelphia, Pa. FREDERICK C. FEARING.

Rubber Better than Steel for Launder Lining

THE EDITOR:

Sir—The article by Arthur B. Parsons in your issue of Sept. 22 describing the successful use of a rubber lining in tube and ball mills interested me particularly because of the use we are making of crepe rubber for lining launders.



Crude crepe rubber on a Malay plantation

On July 17 I laid down in an extension launder on one of the dredges belonging to Kamunting Tin Dredging, Ltd., a mat of crude crepe rubber. This launder is T-shaped; the head extends across the full width of the boxes, and the trunk 6 in. wide shoots the sand 18 in. beyond the end of the boxes. The wear here is very great, as the tailing is fine, sharp sand containing quite an amount of corundum. Usually such launders are lined with granite blocks, ordinary steel plate, or manganese slabs. So far there is no sign of wear of the rubber. About 60,000 cu.yd. travel through this launder in a month.

The lightness of the lining in this particular position is a great advantage, as, with the leverage, heavy material would greatly effect the trim of the dredge.

The following figures are of interest in connection with this mat in comparison with steel of similar thickness.

	Rubber	Steel
Thickness, in.	½	⅛
Total area, sq.ft.	236	236
Total weight, lb.	756	8,260
Weigot per foot, lb.	3.2	35
Cost per lb., cents, Straits	.50	.07
Total cost	$378.00	$578.20
Cost per square foot	$1.60	$2.45

The installation cost of the steel and wastage is not taken into account, but it would be considerable. The mat was made in one piece at a plantation near by, the management of which has made a specialty of crude crepe products. The photograph shows a sample of the rubber used. The cost per pound, 50c., Straits, is probably startling to those who purchase vulcanized rubber only.

We are using crepe rubber at all places on the dredges where abrasion takes place through running sand, such as the drop chute, well lining and stone chute, return drip pan on ladder, and all conduit launders. Probably experiments will be tried on rollers and screen.

We have every reason to expect the crude rubber to last longer than steel, but the experiments are not yet conclusive.

One would expect where abrasion is combined with heavy stress. such as in tube or ball mills and ladder rollers, that the vulcanized rubber would have a longer life than crude. This however can only be settled by experiments. It is said that crepe has been used with success for lining stamp batteries.

Plantations here have had a bad time through overproduction, and are now allowed to sell for export only 60 per cent of their crop, but may sell locally any quantity. The price mentioned is the ruling local price for crepe, nothing being charged for making up the mat, but the estate supplying was of course only too glad to be able to get rid of any of its crop above its allowance.

Under normal market conditions it obviously would not pay an estate to put crepe up in this form, as the work is heavy on rollers, and the labor in cutting and cementing strips is a fairly costly item. The mat referred to above was made in strips of 8 in. by 2 ft. A premium of 10c. a lb. on ruling prices would probably cover the extra costs incurred and also give a resonable profit.

Those who intend using crepe should insist on a fair price, for the prices charged by retailers of crepe shoe soles are ridiculously high. ROY L. NAISH.

Perak, Federated Malay States.

High Grade

THE EDITOR:

Sir—I have been very much interested and have enjoyed reading the several letters which appeared under the caption "Concerning Rich Ore," but believe that so far the main lead has been missed entirely, as to date the Fortuna vein, which traversed several properties in Bodie, Mono County, Calif., has been entirely overlooked. Though the Fortuna was only from one to three inches in width, it is credited with a total production of $30,000,000, and I have seen segments of the vein which ran better than $100 per lb. and many mill clean-ups from operations there ran close to an average of $50 per lb.

The fanciest looking "rock" I have ever seen, though, came from the Little Emma mine, in the Homer mining district, also in Mono County, which was practically pure crystal gold in a matrix of milk-white quartz, individual colors often weighing from $1 to $75, and the gold was so pure that the United States mint returns were as high as $20.60 per oz., and as high as $40 per ounce was paid for individual specimens of perfect crystals by different collectors. O. W. NAY.

Mono Lake, Calif.

Recent Technical Publications

Reviews, Abstracts, and References

Bulletins and Reports

Mine Ventilation—"Ventilation Problems at Champion Reef Mine" are discussed in a 22-page paper published by the Institution of Mining and Metallurgy, Cleveland House, 225, City Road, London, E. C. 1, price 1 sh.

Madagascar Graphite—The geology of the graphite deposits of Madagascar, with a brief description of the methods of mining and mechanical preparation of the material, is covered in an 8-page article, in French, in the *Bulletin des Mines de Madagascar*, for September, Tananarive, Madagascar.

Western Australia Mining—The report of the Department of Mines of Western Australia for 1922, 214 pages, containing a full record of the mining industry in that province during the year, illustrated with numerous charts and maps, is now available from the department, at Perth.

Geological Survey Report—The annual report of the Director of the U. S. Geological Survey for the fiscal year ended June 30, 1923, briefly describing the work done in the year under review, has recently been issued as a 90-page booklet, obtainable on request from the U. S. Geological Survey, Washington, D. C.

Economic Geology—*Economic Geology* for December contains the following papers: "Structual and Stratigraphic Data of Northeast Texas," "Native Copper Deposits of the South Atlantic States Compared With Those of Michigan," and "Geology of the Pearl Lake Area, Porcupine District, Ontario." Price 65c. from the Economic Geology Publishing Co., Lancaster, Pa.

Air Measurement—"Air Measurement Methods for Experimental Work on Fan-pipe Installations" is the title of a paper issued by the U. S. Bureau of Mines, Washington, D. C. as *Reports of Investigations* No. 2,527, obtainable on request. The methods of making the tests in a Butte mine, with detailed tables and calculations, are discussed fully. Pitot tubes and anemometers were used.

Geological Society of America—The Geological Society of America, New York City, has a surplus of certain volumes of bulletins of the society and is willing to sell volumes 2, 3, 4, and 5 at $2 each. There is, however, a shortage of volumes 1, 15, 16, 17, 18, 19, 20, 21, 22, 23, and 24, and $7.50 apiece will be paid for such of these volumes as are returned to the society in good condition, up to a certain maximum number.

Geology of Porcupine—The complex nature of the ore deposits of the Porcupine gold field, in northern Ontario, and the difficulty of making any generalizations regarding that area are brought out by R. C. Feilding in a 10-page paper appearing in the *Bulletin* of the Institution of Mining and Metallurgy for December. Separate copies of the paper may be obtained from the offices of the Institution, Cleveland House, 225, City Road, London, E. C. 1, price 1 sh.

All Institute Members May Now Borrow Technical Books

A PLAN just adopted by the Engineering Societies Library, 29 West 39th St., New York City, should prove helpful to those engineers who reside at a distance from a good technical library. Any book published in recent years may now be borrowed, provided the borrower is a member of one of the engineering societies which support the library. Those residing out of town will be required to pay the carriage charges, and a small fee, probably 5c. a day, will be exacted for the time that the book is in possession of the applicant. Particulars may be obtained on application at the address above mentioned. Photostat copies of desired pages from magazines and books may also be obtained from the Engineering Societies Library as before.

Patents

Mine Car Tracks—No. 1,472,696. Oct. 30, 1923. Marion Stufflebeam, St. David, Ill. A method for handling cars in mines with intercommunicating parallel and lateral entries.

Cottrell Process—No. 1,472,231. Oct. 30, 1923. W. A. Schmidt, Los Angeles, assignor to International Precipitation Co., Los Angeles. A further development in the Cottrell process of fume precipitation.

Roasting Furnace—Nov. 6, 1923. R. D. Pike, San Francisco. A multiple-hearth roasting furnace, with a lower hearth that is much enlarged, providing space for the combustion of extraneous fuel.

Copper Precipitation—No. 1,472,115. Oct. 30, 1923. L. F. Clark, Potrerillos, Chile. A solution containing copper is subjected to high temperature and pressure and to a reducing agent including formic acid to precipitate the copper.

Concentrator—No. 1,472,670. Oct. 30, 1923. A. H. Penfield, New York City. An apparatus with several suspension compartments communicating with each other, and means for introducing ore and water into the lower compartment, and discharging the products.

Treating Lead-Zinc Ores—No. 1,473,193. Nov. 6, 1923. P. A. MacKay, London, England. Ores containing lead and zinc sulphides are crushed and subjected to the action of sulphuric acid and sulphur trioxide which changes the lead to the sulphate form but does not attack the zinc. The action is exothermic, providing the necessary heat.

No. 1,473,447. Nov. 6, 1923. M. O. Sem, Christiania, Norway, assignor to Det Norske Aktieselskab for Elektrokemisk Industri, Christiania, Norway. Complex lead-zinc sulphides are subjected to heat in the presence of a substance which alloys principally with only certain of the metals present, and at such temperatures that decomposition of the sulphides of the alloying metal is effected and an alloy thereby formed.

Placer Mining Machine—No. 1,473,039. Nov. 6, 1923. T. F. Harkins, Denver, Colo., assignor to The Little Giant Machine Co., Denver. A spiral conveyor, feeding sand and water to a system of riffles and pockets for collecting valuable mineral from placer deposits.

Rock Drills—No. 1,472,040. Oct. 30, 1923. L. C. Bayles, Easton, Pa., assignor to Ingersoll-Rand Co., Jersey City, N. J. A drill with automatic air feed and rotation motor control.

Patent No. 1,472,424, issued to the same applicant, covers an oiling device for rock drills.

Treating Gases with Liquids—No. 1,471,332. Oct. 23, 1923. W. E. Greenawalt, Denver. This patent covers means for mixing gas and liquid, as in introducing sulphur dioxide into ore leaching solutions, or air for purposes of oxidation. The gas is introduced at the bottom of a vessel, and an impeller attached from a shaft driven from above, used to agitate the fluid and mix in the gas.

Treatment of Iron Ore—No. 1,472,131. Oct. 30, 1923. A. J. Moxham, New York City. Pure iron is obtained by leaching the ore with a solvent for iron, separating the solution from the gangue, evaporating the solution and heating to form oxide; reducing to the magnetic oxide with carbon and heat; and separating the reduced oxide by magnetism.

Patent No. 1,472,860. Nov. 6, 1923. S. J. Vermaes, Delft, Netherlands, assignor to Syndicaat "Electro-Staal," The Hague, Netherlands. Finely ground iron ore is treated at a high temperature and mixed in a reducing furnace with finely divided solid fuel without access of air or gases. The furnace is heated externally to such a temperature as will give a rapid reaction between the oxygen of the ore and the carbon of the fuel. The solid metallic iron is then drawn off, melted, and separated from the slag.

Iron from Smelter Slag—No. 1,471,270. Oct. 16, 1923. C. R. Kuzell, Clarkdale, Ariz. A process for reducing the iron in copper smelter slags to the metallic form by blowing in a converter with a blast of air charged with carbonaceous fuel. Suitable flux is provided, and above the bath another blast is introduced to support combustion. The problem of treating copper slags to recover the iron is arousing the attention of several metallurgists, and this work at the United Verde is one of the promising methods tried.

Societies, Addresses and Reports

Geological Society of America Meets at Washington

David White Retires as President—Paleontological and Mineralogical Societies Also Present

THE Geological Society of America held its annual meeting in Washington Dec. 27-29. With the G. S. A. met also the affiliated societies, the Paleontological Society and the Mineralogical Society of America. The meetings were held in the Interior Building. Substantially, the visiting geologists were the guests of the United States Geological Survey and of the Geological Society of Washington. All arrangements were carefully made and everything went off with a businesslike precision which was very marked.

David White, the retiring president of the Geological Society of America, delivered a notable address on "Gravity Observations from the Standpoint of Local Geology," in which he made a distinct contribution to the problem of isostasy by dwelling on the relative bulk and densities of sedimentary rocks in the different geologic provinces of the eastern and central United States, and their bearing on the so-called anomalies of specific gravity as determined by the pendulum of the geodesists. While the problem of isostasy is far from being clear, this address added distinctly to the data which are accumulating to eventually make the subject more precisely understood.

The retiring president of the Paleontological Society, Dr. T. Wayland Vaughan, delivered his presidential address Thursday noon, Dec. 27, the subject being the "Criteria and Status of Correlation and Classification of Tertiary Deposits." The president of the Mineralogical Society of America, Dr. E. T. Wherry, gave his presidential address Saturday noon, Dec. 29, on "The Surface of a Crystal."

Sixty-five papers were listed—and most of them presented—at the sessions of the G. S. A. It is manifestly impossible, therefore, to give any detailed account of the program whatever, especially as each paper was thrown open for discussion. Moreover, the Paleontological Society presented twenty-three papers, in addition to a symposium; and the Mineralogical Society brought out twenty-two papers. Among papers of especial interest to the student of mines and ore deposits were those on "Fumarolic Incrustations of the Katmai Region," by E. G. Zies; on "Dolomization in Southern Nevada," by D. F. Hewett; on "Primary Silver Ores of South Lorrain," by E. S. Bastin; and on the "Paragenesis of the Bolivian Tin Ores," by George M. Hall.

Announcement was made of the election of Prof. Waldemar Lindgren as president of the Geological Society of America for the year 1924.

A field trip to points of petrographic and mineralogic interest was arranged for Dec. 30, and attended by many members, one of the chief objectives being the observation of pegmatitic dikes in diabase in the vicinity of Washington.

Saturday evening was the date of the annual dinner of the G. S. A. and of its affiliated societies, the Mineralogical Society and the Paleontological Society. Prof. J. F. Kemp was toastmaster. The speakers included, besides the outgoing and incoming presidents of the G. S. A., Prof. C. K. Leith, Prof. A. C. Lawson, and others. Beautifully engraved testimonials were given to the former secretary of the society, Dr. Edmund Hovey, who retired last year, and to the veteran geologist and teacher, Prof. William Rice. The rest of the dinner program was in the hands of the Pick and Hammer Club of Washington, which gave one of its characteristic entertainments, consisting of song and burlesque. The songs and impersonations were after the style of those of the famous Gridiron Club of newspaper men in Washington, and delectably hit off some of the prominent members of the G. S. A., including Dr. George Otis Smith, Prof. Reginald Daly, Prof. A. C. Lawson, J. E. Spurr, and many others.

Society of Economic Geologists Holds Business Meeting

The Society of Economic Geologists held a luncheon and annual business meeting in Washington Dec. 29. The annual meeting for the presentation and discussion of papers, together with the annual dinner and presidential address, will take place in May, probably in New York. The retiring president, J. E. Spurr, presided at the meeting. He announced that the outstanding events of the year in the history of the society had been the establishing of an independent annual gathering in May, for scientific and social interchange, and also the establishing of the Penrose gold medal for distinguished contribution to the earth sciences. There were short speeches and much animated discussion on the problems of the Society.

Announcement was made of the election of J. F. Kemp as president of the Society for 1924, and of E. S. Bastin as vice-president. New councilors are D. F. Hewett and G. F. Ashley.

Statistical Association Hears Mining Problems Discussed

One of the sessions of the eighty-fifth annual meeting of the American Statistical Association held at the New Willard in Washington, D. C., on Dec. 28, was devoted to mining. Senator Oddie, of Nevada, presided, and introduced Dr. George Otis Smith, of the Geological Survey, who read a paper, prepared by himself and associates and illustrated by graphical charts, on the fluctuations of mineral output. Mr. Smith stated that the primary aim of his paper was to examine the several mineral commodities and to see which of them were the most sensitive and significant business indicators. Taking up the metals and minerals one by one and showing the curves from which his deductions had been made, he concluded that pig-iron production was probably the most useful of the available mineral barometers. The cement production curve was also useful. The output of petroleum is the least sensitive to business cycles. Not enough data were available in copper, lead, and zinc to make the record valuable enough for business barometers. Mr. Smith said that the "producers of copper can help to stabilize American business by arranging to publish currently and promptly full statistics of their production, shipments, and stocks." Perhaps the most significant figures, so far as sensitivity goes, were those of electric power production. Electric power faithfully reflects all business, and because it is consumed as quickly as produced, the production curve is also a consumption curve,

The effect of new processes on the past and future production of petroleum was next discussed by J. E. Pogue.

"Trade Statistics and the Nonferrous Metals" was the subject of a joint paper by F. E. Wormser and E. H. Robie, assistant editors of the *Mining Journal-Press*, read by the former. It was a plea for greater frankness on the part of the copper, lead, silver and other metal producers regarding the statistical compilations, which are now privately circulated. It also urged cooperation by consumers to enlarge the statistical picture. The paper appeared in last week's issue of the *Mining Journal-Press*.

D. L. Wing and F. G. Tryon presented a paper on the "Bituminous Coal Industry in Prosperity and Depression," containing valuable statistical data.

The discussion was enlivened by the remarks of S. S. Tuthill, secretary of the American Zinc Institute, who criticised the Department of Justice for failing to define the class of statistics that could or could not be gathered by trade associations, and those that could not be privately circulated. He stated that his organization felt it was "holding the bag" while other metal industries were getting away with secret compilations and that the American Zinc Institute contemplated making a change unless it could find some support for its course.

MEN YOU SHOULD KNOW ABOUT

Dr. E. P. Mathewson has returned to New York from Peru.

W. J. Loring has returned to San Francisco from Boston.

W. R. Pennick, of the Hardinge Co., was recently in San Francisco.

Arthur W. Jenks is examining mining properties in Idaho for eastern investors.

H. B. Bulmer, manager for the Comstock Leasing Co., at Virginia City, is in San Francisco.

C. E. Decker is now custodian for the Oklahoma Geological Survey, at Norman, Okla.

Roy A. Sulliger is in charge of the operations of the Pintas Mines Co., near Ajo, Ariz.

Prof. M. M. Leighton is now chief of the State Geological Survey Division of Illinois, at Urbana, Ill.

G. C. Bateman has been nominated as a vice-president of the Canadian Institution of Mining and Metallurgy.

Colonel Joseph Hyde Pratt is now Director of the North Carolina Geological and Economic Survey, at Chapel Hill, N. C.

Robert Livermore has been made managing director of the Smuggler Union Mining Co., operating the Smuggler mine, in Telluride, Colo.

Kirby Thomas left New York on Dec. 29, 1923, for a two weeks' trip to Butte, Mont., and Salt Lake City. He will examine mining properties in that region.

Colonel Glenn S. Smith is in Austin to attend a meeting of the Governor's advisory Council of Engineers, called by Governor Neff of Texas to meet on Jan. 8.

Amos L. Beatty, president of The Texas Company, and a party of officials of that company made a complete inspection of the Oklahoma properties during December.

Dr. Rudolf Gahl and **O. C. Ralston** are taking the preliminary steps toward the formation of a new section in San Francisco of the American Electrochemical Society.

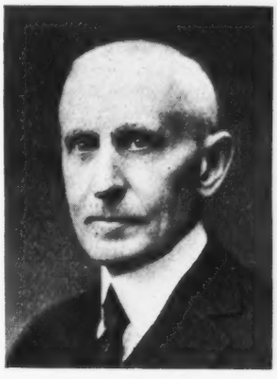
R. C. Wallace is the head of the Department of Geology and Mineralogy of the University of Manitoba, at Winnipeg. He is assisted by **J. S. De Lury**, **T. B. Root**, and **C. A. Merritt.**

D. G. Sinclair, who for some years has been engaged with the International Nickel Co. of Canada, has been appointed assistant inspector of mines for Ontario, with headquarters at Sudbury.

R. B. Walthall, chief supervisor of the oil and gas division of the Texas Railroad Commission, and **W. F. Arnold**, deputy supervisor, will soon make an extensive inspection trip through the shallow oil fields of eastern Texas.

Edwin J. Collins, Calumet, Mich., vice-president of the Calumet & Arizona Mining Co., is spending the holidays in Duluth. He recently returned from Mexico and was in the zone of rebellion at the time of his visit to that country.

Harrison E. Clement, consulting engineer of Salt Lake City, Utah, and Butte, Mont., has been appointed general manager of the Premier Paymaster, and the United Mineral Lands Corporation, which will develop the property adjoining the Paymaster in Deloro Township, Ont. Mr. Clement is now at the property.



Victor G. Hills

Victor G. Hills recently completed a study of the mining geology of the Cripple Creek area, making detailed geologic plans and sections of underground workings.

J. Alvin Gardner, first assistant to the vice-president in charge of the Gulf Production Co.'s Fort Worth office, has resigned to enter the oil producing business for himself. Mr. Gardner has been with the Gulf Production Co. since 1908, when it was operating under the name of the Guffey Petroleum Co.

J. B. Pierce, Jr., of the Barium Reduction Corporation, of Charleston, W. Va., and, on occasion, a valued contributor to the columns of the *Journal-Press*, is recovering from a serious illness from which he has been incapacitated since last July. He expects to spend the winter in southern California.

H. Schreiner, O. Storance, O. J. Willock, Prof. Frederick Jacobsen, and **John Marstrand Jargensen**, all of Christiania, Norway, visited Pittsburgh and some of the larger eastern cities recently. They will inspect the electrical industries of the United States with a view to making a recommendation to their government for the purchase of millions of dollars worth of electrical equipment.

Dr. Joseph T. Singewald, Jr., professor of economic geology at the Johns Hopkins University, and **Mr. Lincoln Ellsworth**, of New York, will sail for Peru in February to make a geological cross-section of the Andes of central Peru. The expedition will be known as the Ellsworth Expedition and the geologic materials secured will be studied at the Department of Geology of the Johns Hopkins University.

W. E. Hall, a hydraulic engineer on the staff of the U. S. Geological Survey, has accepted the position of secretary-treasurer of Western North Carolina Incorporated, an organization devoted to the study and development of the natural resources of western North Carolina. He will remain district engineer for the Survey until **E. D. Burchard**, who is to succeed as district engineer, can be transferred from Hawaii.

Dr. Thomas Crowder Chamberlin, teacher geologist and writer, attended the meeting of the American Association for the Advancement of Science in Cincinnati last week. In his address he said: "Radioactivity has furnished direct evidence of as high antiquity of the lower rocks as perhaps either geologic or biologic interpretation requires. Some geologists do not now hesitate to think that the earth may be some few billions of years old. Our knowledge of the material of the earth has been greatly increased by the thousands of chemical analyses that have been made in increasing numbers as the epoch progressed. Until recently geologists thought that the earth had inherited its heat from the time it was a white-hot star. We now know that it is possible that most, if not all, of the present heat of the interior of the earth is the product of transformations of substance now going on deep beneath the crust on which we live." Doctor Chamberlin is now in his eighty-first year.

OBITUARY

Peter Kirkegaard, well-known mining engineer, of Toronto, died on Dec. 23, 1923, after an illness of six weeks, in his seventieth year. Mr. Kirkegaard was educated in Norway and came to Canada in 1896, having previously had many years' experience in mining in Australia and South Carolina. For several years he was managing director of the Deloro Mining & Reduction Co., and was the first man in Canada to refine white arsenic. He subsequently became connected with the North Dome mine and acquired other interests in the Porcupine field, but latterly his activities had been confined to engagements as consulting engineer. Mr. Kirkegaard was vice-consul for Denmark, and prominent in fraternal organizations. He was a Mystic Shriner, and a member of several professional societies, including the North of England Institute of Mining and Mechanical Engineers.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary of the Week

THE total value of the metal production in British Columbia increased in 1923. Gold and silver output was less, but the diminution was more than offset by increases in copper, lead, and zinc.

Tonopah bullion production seems now stabilized at about $320,000 per month.

The Engels Copper Co. has completed the long haulage adit that will cut its mining costs.

The Calumet & Hecla Consolidated is mining 75-lb. copper rock from its upper conglomerate levels.

Purchase of the Brunswick mine, in the Grass Valley district in California, is being considered by the United Eastern Mining Co. of Arizona.

Good ore is being developed in the Old Dominion mine in the Colville district in Washington.

The International Nickel Co. has materially increased the efficiency of its operation at Sudbury.

George Otis Smith differs with the Department of Justice as to advisability of publishing mineral production statistics.

Railroad to Cobalt or Concentrator at South Lorrain?

Mining Corporation Defers Construction Pending Decision on Railroad —Much Development

The Mining Corporation of Canada is considering the erection of a mill on its property in South Lorrain, but final decision on this matter will depend on whether or not the branch railway from Cobalt is to be built. The government has made the surveys and is preparing estimates of the cost, but has as yet made no announcement regarding the construction. The building of this road, which would be about 20 miles long, would be of great importance not only to South Lorrain but also to Cobalt. South Lorrain is now a very important camp, and its production may surpass that of Cobalt in the comparatively near future. Adequate transportation is, of course, essential, and at the present time everything has to be transported over a road 23 miles long.

The two producers are the Keeley and the Mining Corporation, with an output of over 3,000,000 oz. a year. The Lorrain Trout Lake is developing good ore and seems assured of a profitable future. Other promising properties are the Maidens and Belle Ellen, both being financed by English capital. If the railroad is built it will not only greatly assist the development of all those properties, but will provide a outlet for milling ore. The Mining Corporation has a plant in Cobalt capable of treating 300 tons a day, and as the Keeley is the only property in South Lorrain which has a mill, the other properties would no doubt ship their concentrating ores to Cobalt. The Mining Corporation and the Lorrain Trout Lake already have a very considerable tonnage of such ores available.

If the railroad is not built the Cobalt mill will probably be dismantled, as the Mining Corporation has not much ore left in its Cobalt properties and has a new mill in South Lorrain. This would be unfortunate for Cobalt, because the Mining Corporation plant is the only customs mill in Cobalt and is treating ore for two other companies.

Northwest Magnesite Co. Absorbs American Mineral Production Co.

Merger of Washington Magnesite Producers Will Effect Economies— Railroad Included in Deal

The Northwest Magnesite Co. of Chewelah, Wash., has taken over all of the property of the American Mineral Production Co. at Valley, Wash., for a consideration of approximately $1,000,000, according to announcement of C. R. Moore, general manager of the American Mineral Production Co. Transfer of the property will take place on Feb. 1. All of the real and personal property is included in the transaction including a six-mile railroad.

The American Mineral Products plant is at the mine from which the finished magnesite is shipped over the six miles of railroad included in the sale. The Northwest Magnesite Co. mine operations are near the property of the American Mineral Production Co., but teams are in use to take the crude to the plant six miles eastward. The Northwest Magnesite Co., will use the railroad in carrying crude magnesite from both mines to the plant on the Great Northern Ry.

Dominion Company, In Washington, Develops Large Oreshoot

Lead, Copper and Silver in Ore—70-Ft. Inclined Winze Still in Good Orebody — Produced Years Ago

Development of the recent strike in the Old Dominion mine near Colville, Wash., now being operated by the Dominion Silver Lead Mining Co., is rapidly revealing a large orebody. The strike was made on the lowest level in the mine 600 ft. below the surface and over a half mile from the portal of the tunnel. An incline shaft has been driven 70 ft. below the level in the orebody. The ore at the bottom of the shaft contains galena, tetrahedrite, and native silver, which is woven through the rock in wire form. From the bottom of the shaft a drift extends 15 ft. in ore and a drill hole 12 ft. farther is still in ore. How large it will prove to be can only be estimated from the dimensions so far disclosed. Assays made of general samples and drill holes show from 144 oz. to 684 oz. silver.

The Old Dominion mine has a production record of $650,000, mostly from near the surface. A shipment of thirty-three tons about a year ago netted the present company $17,000 from the smelter. This small orebody was discovered on the lowest level about 350 ft. from the site of the present strike. The mine produced its greatest shipments in the 80's and was idle for many years until the present company was formed, a few years ago. W. H. Linney, former manager of the Nipissing mine, in Ontario, is president and manager. Spokane and Colville stockholders to the number of forty comprise the company.

Calumet & Hecla Mines 75-Lb. Rock From Upper Levels

Cuts Per-Pound Cost—Allouez Ground Will Be Mined Through Other Shafts; Fruit of Consolidation

Fully half of Calumet & Hecla's production from the conglomerate department of its Michigan mines, about 2,000,000 lb. of refined copper per month, is coming from the upper levels of the conglomerate shafts, from the backs of stopes, arches, and pillars. This rock is rich, running 60 to 75 lb. of copper to the ton of rock. A number of years will elapse before the shafts are mined from the haulageway at the 81st level upward, after which the lode will be mined at greater depth from the haulage tunnel. The conglomerate at depth is richly charged with copper, but the lode is wider and closer selection than is employed in the upper levels is necessary.

Calumet & Hecla consolidation will make for economy in the development and mining of its copper areas. As an example, Allouez probably will not again be worked as a unit in itself, for this ground can be reached through the Kearsarge shafts of the Osceola branch and also from Ahmeek. It will be advisable to open Allouez in this way, thus saving the cost of hoisting and shaft maintenance at Allouez. Concentration of mining operations will be advantageous to the consolidated company and was one of the chief reasons for the merger of the subsidiaries with the parent company. Similar arrangements elsewhere can be put into effect when workings now idle are reopened.

Quincy Will Open No. 8 Shaft by Spring

No. 8 shaft, Quincy, will be reopened as soon as labor conditions in the Michigan copper country permit. More underground workers are being steadily added to the force in Nos. 2 and 6 shafts, and No. 8 probably can be in operation by spring. This shaft has been closed for some time, due to shortage of labor only. Physically, it is in splendid condition and will contribute considerably to Quincy's output. In the 10½ months it was in operation in 1922, No. 8 produced 217,573 tons of copper rock and 189 tons of mass copper. The shaft is bottomed 59 ft. below the 75th level and is well opened by drifts and stopes. The bottom levels are well prepared for mining operations, having extensive stopes, particularly on the east branch of the Pewabic bed in which the best values are found. A new drum was installed on the hoist at No. 8 in 1922, which will make it possible to sink the shaft to a much greater depth.

Nevada Cyanide Plant Starts

The 50-ton cyanide plant has been completed at the property of the Unionville Mining Co., south of Winnemucca, Nev., and will be put into operation at once.

Butte & Superior Copper Shipments Break Record

BUTTE & SUPERIOR for the six days ending Dec. 22 shipped approximately 6,200 tons of crude zinc ore and 2,700 tons of copper ore from its Black Rock mine, at Butte. This establishes a new high record for copper ore.

State Mine Inspector Condemns Project of Idaho Gold Corporation

By Wire to Journal-Press from Boise, Idaho

Stewart Campbell, State Mine Inspector for Idaho, after a personal inspection of the property of the Idaho Gold Corporation at Rocky Bar, Idaho, has issued a public warning to prospective purchasers of shares of that company. He states that samples taken by him from the vein which recent press articles declared assayed $475 per ton in gold, did not assay to exceed $36; that the vein does not have the appearance, in his opinion, of promising the development of a mine. He says that the company, of which Samuel Newhouse was recently elected president and manager, has never complied with the blue-sky laws of Idaho, and that its advertising circulars and press articles are misleading.

Alaska Placer-Gold Production Declined in 1923

Shortage of Water One Drawback—Hammon Interests May Return to Fairbanks Placers

Alaska's placer gold production for 1923 is somewhat less than for 1922. This is partly due to two months of unusually dry weather. The lack of water seriously handicapped most of the operations. Twenty-eight dredges were operated during 1923—five more than in 1922. Nineteen dredges were operated on Seward Peninsula. The two Hammon dredges at Nome were reported to still be operating on Dec. 1 with the temperature at 4 deg. below zero. Shortage of water handicapped the cold-water thawing operations there and trouble was experienced in getting the points down to bedrock in the deeper ground. Holes are being drilled this winter, in which the thawing points will be placed next spring.

The Hammon Consolidated interests have also obtained the Powell holdings adjoining. They are overhauling the old 8-cu.ft. dredge on Wonder Creek and will place it in operation next season. They plan to build another new dredge and to add two more Diesel units to the power plant if these can be financed. They did not do anything this season in the Fairbanks district, although they intimate that after they have worked out certain problems at Nome that they will then turn to the Fairbanks country.

United Eastern May Buy Grass Valley, Calif., Mine

Reported To Be Considering Brunswick Property—"Discovery" of Old District Stimulates Interest

It is reported that the United Eastern Mining Co. of Oatman, Ariz., has been looking over the Brunswick mine, near Grass Valley, Calif., and is considering its purchase. The United Eastern Mining Co. has been looking for a property for some time but without success. As the Grass Valley district has been recently "discovered," it would not be a matter of surprise to find the United Eastern looking closely into the possibilities of this area, which has been accepted as an old gold-mining camp, but which apparently afforded no attractions until silver mining in Nevada became depressed. Then several Nevada mining companies discovered that there were opportunities in the Grass Valley district and acquired properties. As a result of the work on the Idaho Maryland the Brunswick was unwatered and put into operation. This property has a good record of production and has been explored to a relatively shallow depth.

The North Star and Empire mines have followed their vein systems to a vertical depth of 3,000 ft. It may be assumed that both the Idaho Maryland and Brunswick present excellent opportunities for exploration at greater depths. If the United Eastern takes over the Brunswick, undoubtedly a systematic and energetic effort will be made to explore its possibilities at greater depths.

Engels Completes Long Adit; Will Cut Production Cost

The Engels Copper Mining Co. has about completed its No. 10 tunnel and two raises, one a double compartment for cage and manway and the other an ore pass from the upper levels to No. 10 tunnel, are being driven. The connecting mine railroad between the portal of the tunnel and the Superior mill, a distance of 6,500 ft., has been completed. Twenty-two six-ton cars and a six-ton trolley locomotive have been purchased for service in the tunnel. At the mill a two-car rotary tipple is being constructed as well as a concrete ore bin. Changes are being made in the coarse crushing equipment. The result of these improvements will be the concentration of the two camps now maintained into the one at Engels, and more economical handling of the ore.

Lead Mines at Linares, Spain, Are Exhausted

The present lead mines at Linares, Spain, are exhausted, and unless new shafts are opened they will become inactive, according to the U. S. Department of Commerce. When the quotation of lead ore in London is £31 per ton the metal at the wharf in Cartagena brings about 744 pesetas when the rate of exchange is 13.05c.

United Mine, at Ainsworth, B. C., Reopened by New Company

Gets Three-year Option—Lead-Silver Ore on Dump—Shaft To Be Deepened

The United Mines, Ltd., with an authorized capital of $3,000,000, of which, however, only $50,000 is to be subscribed at present, has been formed to take over and operate the United mine, near Ainsworth, B. C. The company has obtained a three-year lease and option on the mine for $60,000, paying 10 per cent down. The mine, which has been idle for fourteen years, was unwatered at a cost of $3,000, and an examination revealed the existance of an oreshoot 15 ft. wide and 150 ft. long, which has been developed to a depth of 220 ft. It is estimated that 5,000 tons of ore is blocked out, and, as only high-grade ore was shipped in past operations, there is a large tonnage of milling ore on the dump. The shipping ore will run around 50 per cent lead and 30 oz. of silver per ton. There is considerable zinc ore, too, which was neglected in past operations. The shaft will be sunk to the 500 level, and if the shoot persists to that depth a mill will be erected. E. J. Edwards, of Spokane, is managing director.

Dividends Resumed by Consolidated M. & S. Co. of Canada

The sum of $628,907 will be disbursed in a dividend by the Consolidated Mining & Smelting Co., of Canada, on Jan. 15, 1924, to stockholders of record on Dec. 31. This is at the rate of 6 per cent on the issue of 419,098 shares having a par value of $10,477,450. This dividend is the first since 1920 and will increase the total to $7,465,784. When dividends were suspended three years ago, the company began a systematic expansion of its holdings and equipment. As a result it owns today one of the finest smelting and refining plants on the continent, situated at Trail, B. C., and a large number of mines in British Columbia and Washington that are shipping to the smelter. Its Sullivan zinc-lead mine at Kimberley has been referred to as the largest in the West. The number of its employees is 2,400, about twice as many as when the program of expansion was started in 1920.

Elbow Lake Property Will Be Further Developed

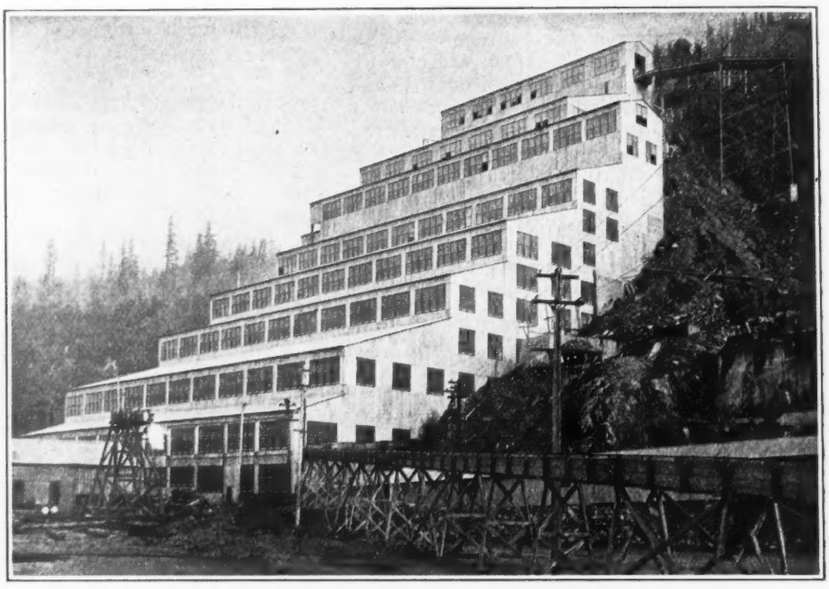
The Gordon Murray Gold Mines, Ltd., of Elbow Lake, Manitoba, has been reorganized with a reduction of its capital from $2,500,000 to $2,000,000 the shareholders being allotted $500,000 for the $1,500,000 issued and $1,000,000 remaining in the treasury. An English syndicate has arranged to purchase a block of the treasury shares for $50,000 and made the first payment. About $100,000 was spent on the property when it was under option to the Hollinger.

British Columbia's Base-metal Production Increases

Gold and Silver Output Declines—Premier Output Less—Big Gain in Copper Follows Resumption at Britannia Beach by Howe Sound Company

By Robert Dunn
Special Correspondent

BRITISH COLUMBIA'S mineral production for 1923 shows an increase of 12.8 per cent, in monetary value, over that of 1922, according to a statement issued by William Sloan, Minister of Mines. The output is valued at $39,699,758, against $35,158,843 for the previous year, an increase of $4,540,915. The production of 1921 had a value of $28,066,641, so that in two years the industry has made an advance equal to $11,633,117, or 41 per cent.



New concentrator of the Britannia M. & S. Co. on Howe Sound, B. C. Produced 20,000,000 lb. of copper in 1923

Metals that show an increase, together with comparative statistics, follow:

	1922	1923, Estimated
Gold (placer), oz.	18,240	20,000
Copper, lb.	32,359,896	54,000,000
Lead, lb.	67,447,985	74,000,000
Zinc, lb.	57,146,548	62,000,000

Metals showing a falling off in production, with the comparative figures, follow:

	1922	1923, Estimated
Gold (lode), oz.	197,856	174,000
Silver, oz.	7,101,311	6,708,000

The increase in the placer gold production is regarded as encouraging, although it is estimated that the improvement will be no more than some 1,760 oz. There are two reasons for this advance in production. One is greater activity on the extensive placer grounds of the Cassiar region, northern British Columbia, and the other the continued favorable development of the Cedar Creek section of the Cariboo district.

The advance in copper from 32,359,896 to 54,000,000 lb. is explained by the fact that the Britannia Mining & Smelting Co. did not ship in 1922, being without a concentrator, and that its new plant opened early in 1923. As about 20,000,000 lb. is credited to the Britannia mine for 1923, it is clear that the other provincial sources of copper have been little more than holding their own. However, this performance is satisfactory, considering that the price of copper has been no more than one cent a pound better in 1923 than in 1922 and that market conditions have not been altogether to the liking of the producer. The output of the Granby Consolidated Mining & Smelting Co., Anyox, B. C., is placed at 32,000,000 lb. for 1923, so that production of this metal, apart from the Britannia and the Granby mines, has been negligible.

With regard to lead and zinc production for 1923 it is impossible to be anything but enthusiastic. In both metals a new British Columbia record has been established. The lead output of 1922 of 67,447,985 lb. exceeded anything that had gone before, but the 74,000,000 lb. predicted for 1923 is far in advance of the results of any previous year. This and the increase of zinc from 57,000,000 lb. to 62,000,000 lb. are due to the increased production of the Sullivan mine of the Consolidated Mining & Smelting Co. made possible by the completion of the new concentrator at Kimberley, which has a rated

capacity of 3,000 tons per twenty-four hours. The plant, which has been designed with a view to permanency, embodies all the latest improvements known to metallurgical science for the recovery and separation of the silver-lead-zinc contents of the highly complex "Sullivan" ore.

Production of lode gold has declined from 197,856 oz. in 1922 to an estimated 174,000 oz. for 1923, or a decreased valuation of $493,104. The falling off seems to have been general. The Rossland mines, which in the past have been important contributors of lode gold to provincial production, did not ship until late in the year. The Hedley Gold Mining Co. (Nickel Plate) was not operating on a large scale and the aggregate from small shipments from the various districts was not as great as usual. Finally, the Premier Gold Mining Co., Portland Canal, fell a little short of its exceptional gold output of 1922. The Premier, though shipping steadily all year, will produce, for 1923, about 85 per cent of the gold and 66 per cent of the silver mined in 1922. The important new feature is that the company is driving a 2,500-ft. tunnel, of which about 1,000 ft. has been completed, to obtain additional depth of between 500 and 600 ft. on the orebodies, and has announced the addition of 150 tons daily capacity to the mill. The indications are that another concentrator of 1,000 tons or more daily capacity will be built.

Silver decreased in output from 7,101,311 oz. in 1922 to 6,708,000 oz. in 1923, or by 393,311 oz., a monetary loss, as compared with 1922, of $255,000. With the price down on an average of 2c. an oz., and with the Premier mine producing about two-thirds of last year's figure, this was to be expected. It seems that the Slocan is to have a further rival in the Hudson Bay and Dome Mountain zones, about 500 miles south of the Premier mine and on the same contract of the Coast Batholith.

The Federal Mining & Smelting Co., a subsidiary of the A. S. & R. Co., has taken over control of fifteen claims on Dome Mountain, which had been developed in 1922 by the Jefferson Syndicate. Last July, the Duthie Mines, consisting of three properties on Hudson Mountain, was acquired by the Federal, and in September two groups of claims at Owen Lake were bonded and work started soon after. Late in the fall an option was taken on the Idaho group, 12 miles from Usk, but work cannot start until the spring. Offers have been made by the Federal for bonds on two other properties.

The Henderson mine is now equipped with a steam boiler plant, a ten-drill compressor, and incidental machinery. A good motor road has been constructed from the mine to the town of Smithers, and about seventy-five men are employed. The Slocan Star, at Sandon, now known as the Silversmith, and operated by the Silversmith Mining Co., has been producing high-grade mill feed at the rate of about 100 tons a day, as well as probably a considerable tonnage of high-grade crude ore. Other properties that have added substantial amounts to the output are the Wonderful and Ruth, at Sandon, and the Standard, Van Roi, Bosum, and Hewitt at Silverton.

London Will Glimpse $17,000 Silver Nugget

THE Ontario Government has decided to send the big silver nugget purchased from the Keeley Mines Co. operating in the South Lorrain district near Cobalt, to the British Empire Exhibition to be held in London next year. This nugget, which is a section of a 5-ft. vein, weighs 4,800 lb. and is worth over $17,000. South Lorrain is probably the richest silver-producing district in the world, at the present time. The current rate of output is about 3,000,000 oz. per year, all from high-grade ore.

International Nickel Co. Outputs 7,000,000 Lb. Per Month

Improved Efficiency of Labor—Sinter Plant May Displace Heap Roasting

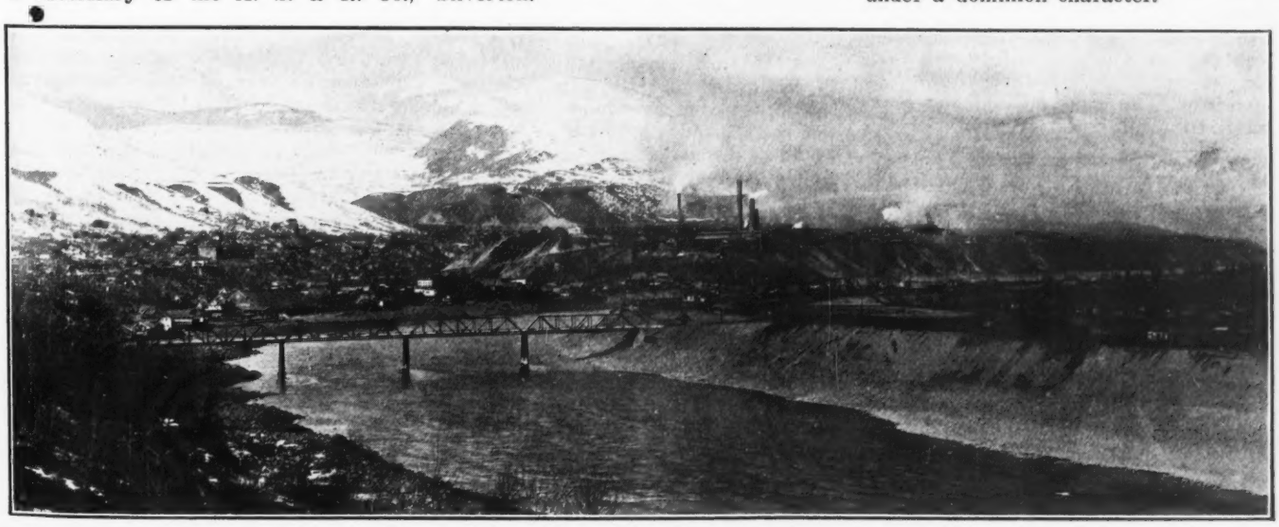
The International Nickel Co. is producing 7,000,000 lb. of nickel per month with approximately 1,000 men on its payroll in the Sudbury, Ont., district. This reflects 30 per cent greater efficiency as indicated by output per man than obtained during the war. Keen attention is being directed to effecting further economies. Whereas previously ore was drawn from four mines, all production now comes from the Creighton.

At present ore is loaded at Creighton, sent west to the new roasting plant, handled there, reloaded and brought back through Creighton to Copper Cliff to the furnaces. An experimental sintering plant in operation at Copper Cliff has been successful. Further tests are to be made, and then it is probable that a big sinter plant will be built at the smelter, eliminating heap-roasting and cutting haulage and handling charges to a fraction of the present figure.

The bulk of the present output is utilized in peace industries. Somewhat less than half goes to Huntington, W. Va., for monel metal and the balance is handled at Port Colborne, Ont. A ductile nickel has been discovered which can be used in boiler tubing. Experiments on nickel for radiators have been encouraging and one large automobile firm is considering introduction of solid nickel radiators.

Dominion Charter Relieves Company from "Blue-sky" Regulations

The Supreme Court of Canada on Dec. 21 rendered a decision confirming the judgment of the Saskatchewan Court of Appeal to the effect that the Provincial "blue-sky" legislation does not apply to corporations operating under a dominion character.



The Trail smelter of the Consolidated Mining & Smelting Co., in British Columbia. Ores from the Sullivan mine are treated here

United States Gold Mines, of Cripple Creek, Resumes Dividends

First Since 1920—Diamond Drilling Program Outlined—New Orebodies Opened

A. E. Carlton, president of the United States Gold Mines Co., as a Christmas surprise to the stockholders, announced that a 1c. dividend on the 4,800,000 shares of outstanding stock would be paid Feb. 16. The company owns 500 acres in the Cripple Creek district of Colorado. This is the first dividend since 1920, and brings the total paid by the company to $569,087.

The company opens the new year with over $100,000 in the treasury. Expanding operations of the company and increased activity of leasers during 1923 were responsible for the discovery of new orebodies which promise well for 1924 production.

With the resumption of operations in the Vindicator mines by the United Gold Mines Co. after the holidays, a diamond drill will be set up on one of the deepest levels, and exploration work will be carried on in the direction of the Hull City, Findley, and Deadwood properties. The program for drilling calls for four holes, but it has not yet been determined just where the drill will be installed first.

Utica, B. C., Mine Financed; Armstead Steps Out

Canadian Mines Merger, Limited, has been formed to take over and operate the Utica mine, in the Slocan, from H. H. Armstead, who recently obtained control of the stock of the old company. Utica Mines, Ltd., has gone into liquidation, and J. R. French, the former secretary, has been appointed liquidator. Owners of Utica stock will receive 1 share of preferred and 2½ shares of common stock for every 11 shares owned in the old concern. The first preferred issue of the new company will be $200,000, and a sinking fund is to be created, whereby 25 per cent of ore shipped will be set aside to redeem the preferred stock. No dividends will be paid on common stock until the preferred is retired.

Moore Mining Co., in California, Continues Shaft Sinking

The Moore Mining Co., operating at Jackson, Calif., is sinking from its lowest level at 640 ft. and will continue sinking to the 1,000 level. An assessment of 1c. per share has been levied to assure funds for the continuance of sinking. The number of shares of this company will be reduced from 5,000,000 to 2,750,000 at a par value of 20c. per share as soon as two-thirds of the stockholders have approved the directors' resolution to this effect. During the months of August and November inclusive a gross production of $66,517 was made and an operating profit of $11,407. A cyanide plant is being built for the treatment of tailings.

Comstock Merger Continues Development on Small Scale

The Comstock Merger Mines Co. operating at Virginia City, Nev., contrary to previous reports, has about 50 men at work at different points, and an official report says that limited development work will be carried on through the winter, with probably a material increase in the scale of operations as soon as weather conditions moderate. The present force is engaged in some new development work and in keeping present workings open. The control of the company was recently acquired by the Consolidated Goldfields of South Africa.

Vermont Talc Producers Merge in $1,500,000 Corporation

The Eastern Mangnesia Talc Co. is the name of a new $1,500,000 corporation that filed articles in Burlington, Vt., recently. The new company is a merger of the Eastern Talc Co., owning mills at Rochester and East Granville; the American Mineral Co. of Johnson; and the Magnesia Talc Co. of Waterbury. The incorporators include Freeland Jewett, of Boston, Mass.; J. Colby Bassette, of Boston; Sherwood E. Hall, of New York City; Warren R. Austin, John S. Patrick and Roy T. Patrick, of Burlington; Joseph T. Smith, of Waterbury, and Ned E. Pease and Edward C. Mower of Burlington.

Copper Export Association Survives, but With Depleted Ranks

Following a meeting of the Copper Export Association held in New York on Jan. 2, R. L. Agassiz, president of the association, made the following announcement:

"The Kennecott interests, the American Smelting & Refining Co., and the Phelps Dodge Corporation have withdrawn from the Copper Export Association to take effect Feb. 1. The association, however, will continue to do business as previously."

For some weeks it has been known that the smelting company had asked to withdraw, and there were rumors that other producers might wish to do the same and that the association would be disbanded. However, the continued existence of the association now seems assured. It is understood that the Phelps Dodge Corporation did not decide upon the advisability of the move until the last minute. A representative of that organization will no doubt immediately proceed to Europe to establish selling connections. Joseph Clendenin will also sail on Saturday to establish an outlet for the export business of Kennecott, Braden, Mother Lode Coalition, Nevada Consolidated, and Utah. Of the Guggenheim porphyries, this leaves only Ray and Chino in the association. The Anaconda interests, including Chile, Cananea, and Inspiration. Calumet & Hecla and other Michigan companies; and United Verde remain in the association. Anaconda will dominate affairs.

Tonopah Output of $320,000 Per Month Considered About "Normal"

Operations Likely To Be Resumed at California Tonopah—Development in West End Mine Continues Good

Bullion shipments from the Tonopah district, representing cleanup of operations during the first half of December, amounted to 190,000 oz. of gold and silver bullion, with an approximate value of $161,500. This indicates normal operations. The West End bullion was valued at $38,700, the Tonopah extension $77,700, and the Tonopah Mining Co. at $45,000. In addition to this production, which is shipped direct to the Tonopah mills, the Tonopah Mining Co. is shipping about 500 tons of surface manganese ore, not amenable to regular cyanide treatment, to the smelter at Kennett, Calif., where the U. S. Smelting, Refining & Mining Co.'s plant is now in operation.

It appears likely that operations will be resumed in the California Tonopah mine, situated in the southeast part of the Tonopah district. Control is held by Stall Brothers, who purchased a controlling stock interest in 1919. Considerable development work was done during the following two years. Several veins were found and prospected, and some ore was shipped, although operations were not profitable. The vertical shaft is 700 ft. deep and an incline winze was sunk an additional 300 ft. to the 1,000 level and some lateral work performed at different levels from this winze. Favorable conditions and formations were encountered, but no commercial orebodies were found below the 700 level, and the property was closed down. Recently an option was granted on a controlling stock interest to a group of Nevada and California men, and the property is now being carefully examined, and if underground conditions are as represented work will likely be resumed soon after the first of the year.

West End operations in the Tonopah "76" property continue favorable. The west drift on the "76" vein is in a total distance of over 50 ft., with the vein carrying commercial values across 2 to 4 ft. for the entire distance, with a wide width of low-grade vein material in the hanging-wall portion of the vein. The footwall rock is Extension breccia and the hanging-wall rock is West End rhyolite, which is known to be at times an important ore-bearing contact. An east drift has also been started and conditions are reported to be about the same as exposed in the west drift. If favorable developments continue in this property it will undoubtedly stimulate mining in this portion of the district, in near-by properties which are not now in operation. One of the most important features about the strike in the "76" ground is the comparatively shallow depth, being but slightly over 600 ft. below the surface. Previous work in this section of the district had indicated a necessity for deeper work to find ore bearing formation.

Good Month for Burma Mines

The Burma Corporation during the month of November mined 20,788 tons of ore at Bawdwin, and 22,440 tons of ore was milled in the treatment plant at Namtu, producing 12,451 tons of lead concentrate; 10,412 tons of lead-bearing material was smelted in the blast furnaces producing 3,489 tons of hard lead for treatment in the refinery. Refinery products were 3,855 tons of refined lead and 425,000 oz. of refined silver. Tonnage milled includes the retreatment of 1,070 tons of tailing. Of silver production 20,700 oz. was recovered from treatment of copper matte.

Alterations to the mill were completed and the experimental zinc plant resumed operations at the beginning of December.

In addition to above, 200 tons of antimonial lead was sold and shipped, and 207 tons copper matte produced ready for shipment from the treatment of accumulated byproducts.

News from Washington

By PAUL WOOTON
Special Correspondent

Conflict in Stand of Geological Survey and Department of Justice on Statistics

George Otis Smith Demands Mineral and Metal Production Data; Justice Department Opposes Dissemination—Present Statistics Inadequate, Says Smith

MUCH significance is attached in Washington to the address made on Dec. 28 by Dr. George Otis Smith, the Director of the U. S. Geological Survey, before the American Statistical Association. Though there was much valuable information in pointing out the respective merit of the curves of mineral production, as business barometers, the feature of the address was the insistence of Dr. Smith on more statistical data from cement manufacturers and from the producers of minerals—a position in direct opposition to the policy of the Department of Justice.

It became known last week that the Department of Justice is opposed not only to the dissemination of trade statistics among members of trade associations, but to the furnishing of such statistics for publication in trade papers, even when they are not distributed in any other way.

The action of Dr. Smith at this juncture is regarded as further evidence that the policy of the Department of Justice tends to be destructive of business and is contrary to the public interest. It is regarded that such a policy must be particularly open to criticism when federal officials such as Secretary Hoover and Dr. Smith—men who frequently have drawn to themselves severe criticism from business interests because of their attempts to safeguard the public—are willing to accentuate the value of these statistics just at the time when the Department of Justice is contending that they are illegal.

Dr. Smith, in his address, urged the producers of copper to help in the stabilization of American business "by arranging to publish currently and promptly full statistics of their production, shipments and stocks." He referred to the monthly statistics of the American Zinc Institute as "a valuable indicator of general business." He pointed out the value to industry of the fact that producers' stocks of cement are available over a long period. At another point in his speech he declared that "the current statistical record of lead, available to the public, is inadequate."

President's Opposition to Department of Mines Explained by Oddie

Expansion of Cabinet Undesirable—The Senator Will Press Bill, However—Importance of Industry

The President is said to be opposed to a Department of Mines. A statement to that effect was made at the White House in response to inquiries which were prompted by the publicity given to a conference between the President and Senator Oddie on the subject.

In this connection, Senator Oddie points out that the White House statement was a cryptic one which does not do full justice to the President's position. Judging from his conversation with the Chief Executive, Senator Oddie is convinced that the President is in thorough accord with any practical step which will benefit the industry which produces nearly as much new wealth each year as does agriculture. He is convinced that the President is anxious that there be greater federal recognition of the mining industry, but he recognizes that the first impulse of any President would be to oppose an expansion in the Cabinet. The fear that the body might become so large as to be unwieldy, Senator Oddie believes, is the very proper motive which influences many persons to oppose a new department. Senator Oddie recognizes that there are no less than a dozen plans actually on foot looking to the creation of new departments. In view of that situation, he is thoroughly in sympathy with the instinctive impulse to shun any such suggestion.

The view of the Nevada Senator is that the mining industry is of such paramount importance that the President or anyone else, when they have had an opportunity to go into the subject fully, will reach the conclusion that this addition to the cabinet is necessary to round it out. Mining and agriculture are the two basic industries. With agriculture represented in the cabinet, its counterpart cannot be denied such representation without a discrimination which none will favor once the full situation is understood, Senator Oddie thinks. He is fully determined to press his bill as vigorously as he can.

London Letter

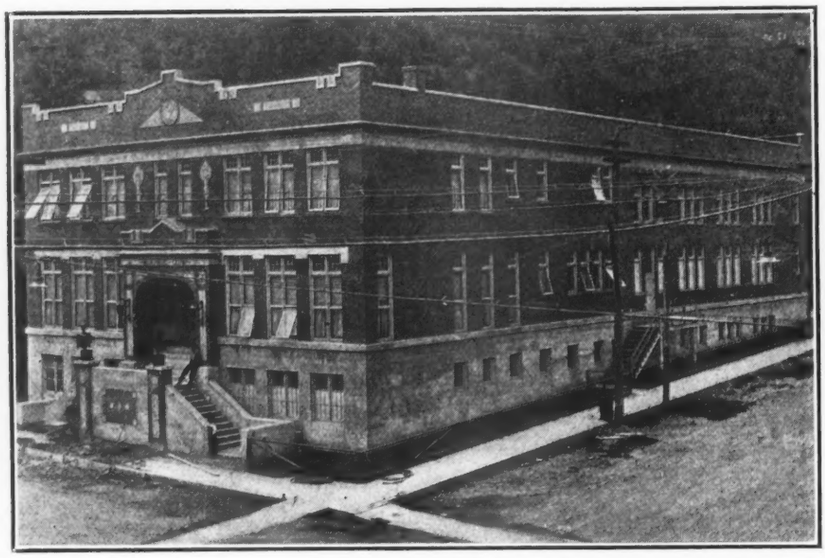
By W. A. Doman
Special Correspondent

London, Dec. 20—On one or two previous occasions I have made reference to the Rhodesia Congo Border Concession, of which A. Chester Beatty is the moving spirit. A meeting of shareholders was held yesterday, at which a résumé of the information already published was given. The company has a five years' monopoly to prospect for minerals over an area about the size of England and reported to be identical, geologically, with the Katanga. Work to date indicates that there is great promise, and in one district an average of 7.1 per cent of copper is shown over a width of 127 ft. Although the producing stage is not yet, estimates are made that the metal can be won much more cheaply than at the great American mines. The Metals Production processes have been tested on a commercial scale at Bwana M'Kubwa, and it is suggested that finished copper will be placed on the London market at a cost which will compare favorably with American copper.

Stansfield Resigns from Waihi Grand Junction

Among mining men quite a little sensation has been caused by the resignation of H. Stansfield from the position of consulting mining engineer to the Waihi Grand Junction Gold Co. (New Zealand). At the annual meeting of shareholders in July last the chairman quoted the consulting engineer as considering the mine now in a condition to give a constant supply of ore insuring fair profits for years, and further that the prospects warranted pushing of development below the No. 10 level. Yesterday an official statement was issued that Mr. Stansfield has, by letter to the board, dated Oct. 12, emphatically disclaimed responsibility for any such misleading communication. On Nov. 20 Mr. Stansfield cabled his resignation. No one can understand the position, and it is asked why if the engineer disclaims responsibility for the misleading communication, he should resign.

The Russo-Asiatic Consolidated has just issued its annual report for the calendar year 1922. No progress is mentioned as regards Russia, but a



The Morning Club. One of the attractions provided by the Federal Mining & Smelting Co. for its employees at Burke, Idaho

hopeful statement is made as to an arrangement with the Soviet authorities. As the Cam & Motor (Rhodesia) deal is also ignored, it is presumed that the shares were bought by Leslie Urquhart and his friends as a private investment.

Paid Too Much for Elmore Process?

The Chemical & Metallurgical Corporation which held its third ordinary general meeting this week, has not yet met with the success that was expected of it, and some of the holders of shares are a little disappointed. Comment has been heard as to the price paid for the patents and rights—£1,000,000 in shares and £25,000 in cash to F. E. Elmore. One technical man remarked that there seemed to be no finality, no real satisfaction, and surprise is expressed that so much paper was handed over before the process was proved. It was stated at the meeting that in the present state of metallurgical knowledge the treatment of complex lead-zinc sulphide ores by the company's processes offers without question "the greatest prospects of success." So that there is still a period of waiting. The chairman confessed to a feeling of disappointment that a plant was not yet running on a commercial scale.

Iron King Ships from Shoot Recently Opened

The Iron King mine, of Eureka, Utah, will soon ship two cars of ore from the strike on the 1,565 level. Ore has been followed 40 ft. in a northwest crosscut on the 1,565 level, and in a raise 30 ft. above this level the ore is 2 ft. thick and has been opened for a length of 12 ft. The ore carries silver, lead, and gold and although it is not exceptionally high in grade, the upward extension of the shoot is being looked for on the 1,300 level. This work is of interest, as the grade of the ore is expected to show an improvement, at higher levels.

Brisbane Letter

Special Correspondence to "Engineering & Mining Journal-Press"

Brisbane, Nov. 25.—One of the government geologists, Mr. Saint-Smith, has reported on the lately discovered silver-lead field, now called the Mount Isa, in the Cloncurry district. Five distinct ore channels at least are traceable over the field, distributed over a total length of about five miles by a width of one mile. The strata in which they occur consist of laminated clay shales and slates, sandstones, quartzites, mudstones, cherts and jasperoid quartzites, and slates, belonging to what are known as the Cloncurry series. The Mount Isa, a lease which includes the site of the first discovery, is considered the most important outcrop. At one point about 16 ft. of 30 per cent ore outcrops; in another part the lode channel is 165 ft. in width. On one other lease a 4-ft. band of carbonate shows 60 per cent lead and 70 oz. of silver per ton; while from yet another a dark powdery mineral which accompanies the galena was proved to contain nearly 63 per cent of lead and over 132 oz. of silver to the ton. The highest assay values recorded of ore from this field were those of two samples from a lease called the Crystal, which went, respectively, 62.30 per cent of lead with 1,960 oz. of silver per ton, and 62.40 per cent of lead with 2,090 oz. of silver.

New Furnace Ready at New Guinea Copper Smelter

The New Guinea Copper Mines, Ltd., having determined to increase its capital, the directors have decided that, of the 125,000 unissued preference shares 50,000 shall be issued to rank *pari passu* with the 125,000 already issued, and that they shall be offered to the present holder of shares at par, in proportion to the number held. The present issued capital of the company is £369,625, in 125,000 preference and 244,625 ordinary shares of £1 each, all fully paid up. The proceeds from the new issue of 50,000 shares are to be utilized in paying off a bank overdraft of £46,000, which has been incurred mainly as a result of unavoidable delays in the starting of operations, due to causes which are stated to have been beyond the company's control. Erle Huntley, the general manager, expects to be ready to blow in the new furnace at the end of November.

Copper Find in Herberton District

An important find of copper, that should prove valuable when the price of that metal improves, has lately been reported from the extreme southern corner of the Herberton field. A recent visitor describes it as one of the best things of the kind he has seen in many years of prospecting and mining in several of the states. The copper lode, with the red oxide showing well out on the surface, can be traced for a considerable distance, averaging about 4 ft. in width on the surface. On the lode being prospected, a bulk lot was obtained estimated to assay 30 per cent copper. The find, like many others, is in a region that has often been prospected before, but this lode, although quite a prominent outcrop, has been missed until now.

New Lead Deposits Are Opened Near Crestline, Kan.

Some good deposits of lead ore have been opened up in the Crestline, Kan., field in recent weeks, and there seems reason for believing the lead output of this district, which has been declining for several years, will show an increase when this new field gets fairly into production.

One of the most recent finds has been at the Crutchfield mill of the Interstate Lead-Zinc Co. This mill was completed and placed in operation only a short time ago, and the lead ore output has been gratifying. Andrew Brothers also have a fine lead producer, and recent drill development has indicated a fine deposit of lead on the Chestnut lease, which is just east of the Hare lease and owned by Isaac Box and associates.

Baden Lead Mines in Germany Are Reopened

Owing to the loss to Germany of the Upper Silesian deposits and the Ruhr situation, the lead and silver mines in Baden, which have not been worked since the Thirty Years' War, have recently been reopened, according to the Department of Commerce. A project is under way to combine the various companies into a single association. Two of the principal companies now employ about 200 men on an eight-hour day basis. The value of the annual production of lead is estimated at $150,000, that of silver at $50,000. The total output is used for local consumption, according to a report from Consul M. K. Moorhead, at Stuttgart, to the U. S. Department of State.

New Machinery and Inventions

Underground Loading Machine Improved

Certain improvements have been made in the Hoar shovel during the past year. These improvements have been chiefly in the character of the materials going to make up the product. These have been:

The substitution of tool steel gears and pinions for the cast steel cut gears.

The substitution of tool steel rollers and pins for the carriage instead of the mild steel sections which were previously used.

Use of cast steel for the axle pedestals instead of cast iron.

Use of nickel-chrome steel in engine crank shafts.

Use of Taylor-Wharton removable dipper teeth instead of the solid sections.

Wider and larger crowd and hoist drums.

Cable sheaves and pins made larger and of better materials.

Cast steel dipper sticks instead of structural steel.

There are in addition to these changes mentioned, a great many changes of a minor nature, all pointing towards cutting down the amount of repairs necessary and giving the machine a longer and more satisfactory life.

To take care of the requirements of the Pennsylvania coal operators and those that have high cars to load, those over 5 ft. above the rail, the company has developed and put on the market its Model S-2 machine. This machine is similar to the standard No. 2 machine, the only difference being that it is higher so as to work in an 8 ft. drift and to load cars 5 ft. to 5 ft. 6 in. above the rail. The first of these machines is to go to the Pacific Gas & Electric Co. on the Pit No. 3 project in California.

Portable Electric Recording Instrument Devised

Among the recent developments by the Westinghouse company is a new portable recording instrument known as Type R. It is made for applications where records as accurate and reliable as those obtained with large switchboard instruments are necessary. Such applications include analysis of motor operation, typical consumption curves of large industrial consumers, and records of power distribution. This instrument is an adaptation of the switchboard recording instrument, with the element as a whole mounted in a portable carrying case. An electric self-winding clock is used for speeds up to 24 in. per hour. For slower speeds, up to 4 in. per hour, a hand-wound clock can be used. Alternating-current ammeters, alternating- and direct-current voltmeters, and single and polyphase wattmeters are included in these portable recording instruments.

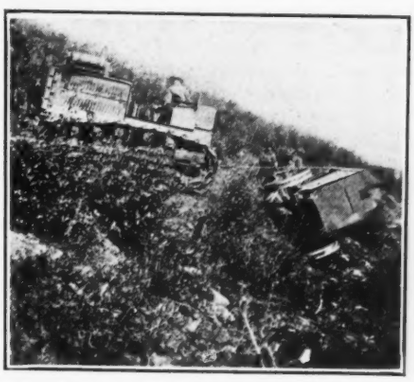
Pulverizing Coal and Other Materials

The latest information of the preparation and application of pulverized coal as fuel is contained in three bulletins just released by the Fuller-Lehigh Co., Fullerton, Pa. One of these, Bulletin 90, entitled "Pulverized Coal for Boilers," is almost a textbook on the manner of using pulverized coal, and on the equipment available for the purpose. Nearly one-third of all coal mined, is burned under stationary boilers, the bulletin states, and by pulverizing almost 25 per cent of this could be saved. Equipment described includes the Fuller-Lehigh crusher, screw feeder, pulverizer mill, indirect-fired drier, vertical and horizontal burners, and the Fuller-Kinyon pump. An insert in the bulletin shows a sectional view of a pulverized coal preparation plant.

Another of the three bulletins, entitled "Fuller-Lehigh Equipment for Producing Pulverized Material," gives condensed information regarding the equipment already mentioned. In addition, it briefly describes Fuller-Kinyon conveying systems, Quigley fuel and transport systems. The equipment described in this bulletin is intended for the economical preparation on a commercial scale of over fifty natural and manufactred products. The third bulletin is the December issue of *Fuller News*, which features the Fuller-Kin-Kinyon conveying system.

Portable Compressor Roughing It Enroute to Keno Hill

In the accompanying photograph is seen a portable compressor enroute through very rough country to its final destination at Keno Hill in Yukon Territory, where the Treadwell Mining Co. had need of it. As shown in the cut, it is being hauled by tractor (and at times by team) from Mayo Landing on the Stewart River to its resting place 50 miles away. The compressor is an 8 x 8 Type 14 portable, made by the Ingersoll-Rand Co., 11 Broadway, New York.



Portable compressor enroute to Keno Hill

Dry Pulverizing With Air-Swept Tube Mills

Certain equipment was installed some time ago in conjunction with a crushing plant for pulverizing limestone. It consists of an elevator for delivering the material to a tower drier, and from the tower drier it is elevated to a bin, from which it is fed by a regulating disk feeder to a 6 x 12-ft. air-swept tube mill. The material is extracted from the mill by a 60-in. fan and delivered through cyclones to the storage bins.

Among the features of the plant are the tower drier, which consists of a system of baffling and requires no power to operate it, and the air-swept tube mill, which is an innovation in the reduction of materials in that it has no discharge lifters and no means of extracting the material except the velocity of the air through the mill. It is equipped with an air box at the feed end and one at the discharge end of the mill.

These boxes have valves on both sides so that the quantity of air delivered at the feed end and taken out at the discharge end regulates absolutely the fineness of the product discharged. The valves on the air box at the discharge end of the mill can be regulated so that the elevating power of the fan is maintained for lifting the material through the cyclones to the bin.

It is claimed that in this way a greater percentage of superfine impalpable powder is obtained from a tube mill than heretofore. This is evidenced by the sifting test, which is as follows: 84½ per cent through 200 mesh; second cyclone all passing a 350-mesh sieve.

When this plant was installed the intention was to produce agricultural lime, 20 mesh and finer. The manufacturers recommended the installation of a double cyclone system for the production of a superfine product which would command a fancy price for dusting on belts and roofing paper to keep it from sticking together before rolling, asphalt filler and other material.

When the plant was started the spring crops had been planted and there was no demand for agricultural lime. By reducing the fan speed and the velocity of the air through the mill, nothing but superfine material was taken out of the mill and a new record was established for three things: Horsepower, tonnage and fineness.

The mill is driven by a 125-hp. motor, direct connected through a silent chain drive and clutch coupling, and the 60-in. fan is driven by a 25-hp. variable speed motor direct connected to the fan by flexible coupling. The electric company furnishing the power determined that the input to the tube mill motor was 120 hp., the input to the fan motor was 12 hp. and the total power consumption for driving the mill and the fan was 132 hp.

This equipment is manufactured by the Kennedy-Van Saun Manufacturing & Engineering Corporation, 50 Church St., New York, N. Y.

Electrochemical Amalgamator Uses Centrifugal Force

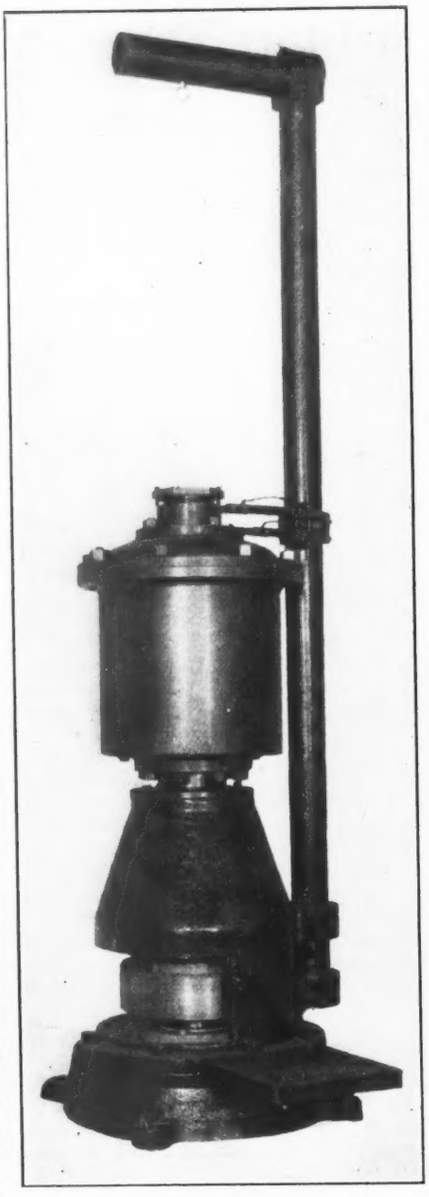
The electrochemical centrifugal amalgamating machine made by the Electrochemical Centrifugal Co., Drexel Bldg., Philadelphia, was described in detail in the *Journal-Press* of March 24, 1923, on page 564. It is shown on this page, in the illustration, which has only recently been obtained. To quote from the previous description, "The machine in its operation is said to develop and utilize centrifugal, pressure, and electrochemical forces, and electrolysis, and by means of these forces properly applied and operating in the machine, the precious metals are entrained in the mercurial cathode and are also held, constantly being collected therein, while the silica and waste material are freely discharged."

As shown in the cut, the machine is substantially built. It runs on Timken bearings. The portion of the pipe extending above the machine is not part of the machine but is used in case it may be desirable at any time to lift out the interior of the machine. By taking off the nuts, the inside may be lifted out, the anode and the top coming out as one piece. A new anode can be put in in five minutes.

The current for the electrolytic precipitation acting in combination with the centrifugal forces can be furnished from a separate source. If desired, the company will furnished the proper generator.

110-Volt Light and Power Plant Useful on Small Jobs

More than one mining company may be interested in learning that a new 110-volt, direct-current light and power plant, known as Type E-63, has been developed by the Westinghouse Electric & Manufacturing Co. to solve the problem of supplying current for light and power in locations where central station service is not available. The plant consists of a gasoline engine, electric generator, and electric starter and control, all built into a single compact unit. It also includes a battery in which to store the electricity from the generator. The fact that the engine is air-cooled makes possible its installation in an unheated outhouse. This plant supplies ample energy for the operation of electric lights and electrical and mechanical appliances. It is economical in fuel and oil consumption, and its slow operating speed and rugged construction provide for long life and dependable service. It operates on either gasoline, kerosene or natural gas. It is not complicated. A hydrometer scale shows the number of hours the plant must be run to charge the battery properly. A dial is then set to the correct number of hours, and the engine is started by merely pressing a switch. When the time has elapsed and the battery is fully charged, the engine is automatically stopped. No other attention is necessary except keeping the fuel and oil tanks supplied.



Total and immediate cleanup is possible with this centrifugal amalgamator, it is claimed

A Handbook of Conveyor and Elevator Belting

The 91-page booklet entitled "Handbook of Conveyor and Elevator Belting," just issued by the Goodyear Tire & Rubber Co., Akron, Ohio, is really a handbook, the company says, and not merely another catalog. It is divided into two sections, one on conveyor belts and the other on elevator belts. There is no doubt that anyone having to do with belting will do well to secure a copy of this handbook. The company is right in asserting that this is what the book really is.

Abundant data and formulas as well as the instruction needed to solve belting problems are found within its covers. It also gives all the information that is necessary for the proper installation and care of belts for both of the purposes named.

New Tool Facilitates Heavy-duty Production Work

A portable electric screwdriver and socket wrench for heavy-duty production work is now being made by the Black & Decker Manufacturing Co., Towson Heights, Baltimore, Md. This tool weighs only 50 lb. and has been designed particularly for driving large wood screws, lag screws, and running up nuts on large bolts. The spindle is equipped with a positive clutch which automatically disengages when the forward pressure on the tool is released. The patented pistol grip and trigger switch is standard equipment on this tool. A universal motor furnishes the power, and all standard voltages up to 250 volts can be supplied.

Centrifugal Pump Development Manifested

The new 72-page catalog issued by the De Laval Steam Turbine Co., Trenton, N. J., exhibits the marked development which has occurred in the improvement of centrifugal pumps, as well as in the direction of larger size and wider use. The rapid extension of the field of the centrifugal pump has been in large part due to improved efficiency, simplicity, and ease of maintenance. The casings are split horizontally, so that internal parts are at once accessible upon lifting the cover.

De Laval pumps are stated to be manufactured to limit gages, assuring interchangeability, so that renewals can be inserted by unskilled men, as they do not require to be fitted, and no adjustments of any kind are required. Centrifugal pumps, driven by steam turbine or electric motor, are used almost exclusively for circulating condenser water, and are also extensively applied for feeding boilers at the highest pressures. In water works service, centrifugal pumps driven by geared steam turbines are built in sizes up to 5,000 water horsepower and over, and realize duties closely paralleling those of the best triple expansion crank and fly wheel pumps. The aggregate daily capacity of water works units built by the De Laval company alone exceeds four billion gallons. Large electric motor driven pumping units show efficiencies from wire to water exceeding 80 per cent, the pumps themselves developing efficiencies as high as 87.2 per cent.

Centrifugal pumps are widely used for fire protection and may be driven by electric motor, steam turbine, or gasoline engine. Gasoline-driven pumps are often provided as stand-bys to motor driven pumps. In the industries centrifugal pumps are used extensively, not only for general water service but also for handling water containing solids in suspension, such as paper pulp or rags, and chemicals.

In a separate pamphlet entitled "Efficiency Tests of De Laval Motor Driven Pumps," the company has published the results of efficiency tests upon several large units installed in municipal water-works plants.

THE MARKET REPORT

Daily Prices of Metals

Dec.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
27	12.75	46.75	47.25	7.60	7.50@7.75	6.275@6.30
28	12.625@12.75	46.375	46.875	7.60	7.50@7.75	6.25@6.275
29	12.625@12.75	47.00	47.50	7.70	7.50@7.90	6.25@6.275
31	12.65	46.25	46.75	7.75	7.75	6.25@6.275
Jan. 1	.....	.....	.....	....	....	.....
2	12.625	46.75	47.25	7.80	7.75	6.25@6.30
Av.	12.680	46.625	47 125	7.690	7.690	6 270

*These prices correspond to the following quotations for copper delivered: Dec. 27th, 13c.; 28th and 29th, 12.875@13c.; 31st, 12.90c.; Jan. 2d, 12.875c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Dec.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
27	61½	62⅜	67¾	235¾	236¾	30½	29¾	32⅞	33
28	60½	61⅝	66¾	232½	234	30⅜	29⅝	32¾	33
31	60⅞	61⅝	66¾	233¾	235¾	30⅜	29¾	32⅞	33¼
Jan. 1	...	...	...	.....	.....	...	...	...	...
2	61¼	62	67	237⅛	238½	30⅝	29¾	33⅛	33¼

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver		Gold London	Dec.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
27	4.34¼	64¾	33 9/16	95s 1d	31	4.31¾	64¼	33 7/16	95s 4d
28	4.34¼	64¾	33⅝	94s 10d	Jan. 1	....	...	33½	95s 8d
29	4.33¼	64⅜	33 9/16	.....	2	4.29	64⅜	33 11/16	95s 10d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Average Metal Prices for December

Copper:	
New York Electrolytic	12.823
London Standard	62.035
London Electrolytic	67.611
Lead:	
New York	7.369
St. Louis	7.369
London	31.042
Silver:	
New York	64.705
London	33.375
Sterling Exchange	435.500
Zinc:	
St. Louis	6.260
London	32.611
Tin:	
99 per cent	46.662
Straits	47.160
London	235.007
Quicksilver	60.000
Platinum	125.000
Antimony	9.365

Metal Markets

New York, Jan. 2, 1924

Copper

The holiday inactivity in the copper market has caused some unrest among two or three sellers who try to make a practice of selling a few million pounds every week or so, and they have accordingly dropped below the 13c. delivered level in order to see if some orders could not be tempted. Some metal has been sold at 12⅞c., but consumers do not seem particularly interested. Monday and today it was pretty generally known that this price could be done for either small or large tonnages for first-quarter delivery. Unless demand is more active, even lower prices will no doubt be made to attract business. Most of the producers, however, are not anxious sellers and would hardly sell below 13c.

Lead

On Saturday, Dec. 29, the American Smelting & Refining Co. increased its official contract price for lead from 7.40 to 7.50c., New York, and today, Jan. 2, a further advance to 7.75c. was made.

The outside market, so called, which consists of the sellers who have lead for prompt or January shipment, continues substantially above the price established by the smelting company, most of the January lead that has been sold in the last week bringing from 8 to 8⅛c. The tonnage sold for early shipment has been larger than for several weeks, several consumers having apparently found that their requirements would be a little greater than they had made provision for. Our reflection of the market therefore shows somewhat more diversion from the A. S. & R. price than in the weeks immediately preceding. In the Middle West, the price has generally been 7.75c. for both St. Louis and Chicago, though as low as 7.45c. has been done for February and March, and 7.90c. for prompt.

Zinc

The market has been quiet at substantially unchanged price levels, 6.25@6.275c. having been quoted for prompt, and 6.275@6.30c. for forward all week. High-grade continues unchanged at 8@8.50c. delivered. Prime Western in New York continues at 35c. per 100 lb. above the St. Louis price, this being the freight differential.

Tin

Tin buying has in general been confined to small tonnages, consumers continuing to a large extent on a hand-to-mouth basis. The market for 99 per cent continues largely nominal. Forward Straits sold for ¼@⅜c. discount from spot.

Tin imports, in long tons, in December and for the year, were as follows according to the New York Metal Exchange:

	1923 December	1923 Twelve Months
Straits	4,670	50,395
Australian	45	440
Banka and Billiton	160	4,018
English	50	7,485
Chinese	360	5,609
Sundries	105	155
Total	5,390	68,102

Foreign Exchange

On Monday, Dec. 31, cable quotations on francs were 5.1025c.; lire, 4.32c.; and Canadian dollars, 2 7/16 per cent discount.

Silver

The market has remained steady with good orders from the Indian bazaars, buying on China account being limited.

Mexican Dollars—Dec. 27th, 49⅜; 28th, 49⅜; 29th, 49½; 31st, 49; Jan. 2d, 49⅛.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—99 per cent, 27c. per lb.; 98 per cent, 26c. London, 98 per cent, £115 per long ton.

Antimony — Chinese and Japanese brands, 10c. W.C.C., 10½@11c. Cookson's "C" grade, spot, 11¼@11½c. Chinese needle antimony, lump, nominal, 6½@7½c. per lb. Standard powdered needle antimony (200 mesh), 7½@8½c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 7.50c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—75@80c. per lb. London, 2s. 6d.

Cobalt—$3 per lb. for spot. Discounts on contracts. Oxide, $2.10@$2.25. London, 11s. for metal; 9s. for black oxide.

Iridium—$275@$300 per oz.

Magnesium—Sticks, 1⅛ in., 99.9 per cent, 90c. per lb. London quotes 3s. 3d. for 99 per cent.

[1]Molybdenum—99 per cent, $12 per lb.

Monel Metal—32c. per lb.

Nickel—26@30c. per lb. for 99 per cent virgin metal. London, £130@£135.

Osmium—$107 per troy oz.

Palladium—$83 per oz. London, £17. Nominal.

Platinum—$125 per oz. Crude platinum, $115 per oz. London, £29 for manufactured; sponge, £28.

Quicksilver—$60 per 75-lb. flask. San Francisco wires $59.35. London, £9¾.

Radium—$70 per mg. radium content.

Rhodium—$100@$105 per oz.

Selenium — Black powdered, amorphous, 99.5 per cent pure, $2.10 per lb.

Tantalum—Metal, $400 per kg.

Tellurium—$2 per lb.

[1]Thallium Metal—Ingot, 99 per cent pure, $8 per lb.

Tungsten Metal—Powder, 97 to 98 per cent, 95c.@$1 per lb. contained tungsten.

Metallic Ores

Chrome Ore—Indian chrome ore, $19.50 per ton, c.i.f. Atlantic ports. Rhodesian, $21.50 and New Caledonian, $24.

Iron Ore—Lake Superior ores, per long ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer. 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore — F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $5 per long ton; old bed concentrates, 63 per cent, $5.25; Harmony, cobbed, 63 per cent, $5.25; new bed low phosphorus, 65 per cent, $7.50.

Manganese Ore—38@42c. per long ton unit, seaport, plus duty.

Molybdenum Ore—80c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates. Nominal.

Tantalum—Foreign, 60c. per lb. of Ta_2O_5 contained, c.i.f. New York. Contains about 65 per cent Ta_2O_5 and 5 per cent Cb_2O_5.

Domestic grades offered at 90c. per lb. of contained Ta_2O_5. Contains about 54 per cent Ta_2O_5 and 24 per cent Cb_2O_5.

[1]Titanium Ores—Ilmenite, 50 per cent TiO_2, $15@$20 per ton. Rutile, 94 per cent TiO_2, 10c. per lb. for car lots.

Tungsten Ore—High-grade wolframite, $8.50; high-grade scheelite, $9.50@$10 per unit. Ordinary grades, $8.25@$8.50. Nominal.

Vanadium—Minimum 50 per cent V_2O_5, $1@$1.25 per lb. Nominal.

Zircon—$50 per ton.

Zinc and Lead Ore Markets

Joplin, Mo., Dec. 29—Zinc blende, per ton, high, $44.70; basis 60 per cent zinc, premium, $42; Prime Western, $41; fines and slimes, $40@$38; average settling price, all zinc ore, $40.16.

Lead, high, $107.15; basis 80 per cent lead, $105; average settling price all lead ore, $100.98 per ton.

Shipment for the week: Blende, 14,980; lead, 2,315 tons. Value, all ores the week, $836,430.

Shipment for the year: Blende, 684,850; calamine, 3,100; lead, 85,300 tons. Value, all ores for the year, $36,682,760, an average of more than $3,000,000 per month, compared with an average of a little over $2,000,000 per month in 1922. For 1916 the value was $37,643,000, and for 1917 it was $40,893,000. Blende purchases this week dropped to 6,650 tons, with prices unchanged.

Platteville, Wis., Dec. 29—Blende, basis 60 per cent zinc, $43.50 per ton. Lead, basis 80 per cent lead, $106 per ton. Shipments for the week: Blende, 460 tons; lead, 166 tons. Shipments for the year: Blende, 32,014; lead, 916 tons. Shipments for the week to separating plants, 650 tons blende.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can only serve as a general guide as to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can only be ascertained by direct negotiation between buyer and seller.

Asbestos—Crude No. 1, $325@$450; No. 2, $200@$250; spinning fibers, $100@$125; magnesia and compressed sheet fibers, $60@$90; shingle stock, $50@$70; paper stock, $30@$40; cement stock, $17@$20; floats, $6@$12—all per short ton, f.o.b. mines, Quebec, tax and bags included.

No. 1 Rhodesian crude, $325; No. 2, $200 per short ton, c.i.f., New York.

Shipments being held back during stock-taking season.

Barytes—Crude, $7@$10 per ton, f.o.b. Georgia mines; $15 per ton, f.o.b. New York. Ground, white, $16@$17; off-color, $13@$13.50, crude $7@$8; f.o.b. Baltimore. Water ground and water floated, $26@$28, f.o.b. St. Louis. Crude, 90 to 98 per cent $BaSO_4$, $8 per ton, on cars at mines in Missouri.

Bauxite—American, crushed and dried, $5.50@$8.75 per gross ton; pulverized and dried, $12@$14 per gross ton; calcined, crushed, $20 per gross ton, all f.o.b. shipping points.

Foreign red bauxite, French, 5 per cent SiO_2, $5@$6.50; Dalmatian, low SiO_2, $6.50@$7.50 per metric ton, according to grade; also quoted $4.65@$6 for other grades.

Beryl—4½c. per lb. f.o.b. Connecticut points. Nominal.

Borax—Granulated and refined, crystals or powdered, in bags, carloads, 5½c. per lb.; in bbls., 5½c. Boric acid, 10½c.

Chalk—English, extra light, 5c. Domestic light, 4½@4½c.; heavy, 3½@3¾c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude No. 1, $7; No. 2, $6; washed, $8@$9; powdered, $13@$20, f.o.b. Virginia points. Imported lump, $15@$20, f.o.b. American ports; powdered, $45@$50, f.o.b. New York. 1A grade, refined, $15@$16 per ton, Delaware.

Diatomaceous Earth—Natural aggregate, $25 per ton; insulating powder, $45; filtration powder, $35; calcined aggregate, $45, f.o.b. plant, California.

Emery—Greek Naxos, 6@7c.; Turkish, 6@6½c.; Khasia, 5@5½c. per lb., f.o.b. factory. American, 4@4½c., f.o.b. shipping points, packed in 350 lb. kegs.

Feldspar—No. 1, $6.60 per long ton, f.o.b. cars; No. 2, $4.50; ground spar, glass trade, $10, f.o.b. mill; pottery grade, $18 per ton ton, North Carolina points.

No. 1, not carrying in excess of 10 per cent SiO_2, $7.90 per ton, f.o.b. New Hampshire points.

In Maine, No. 1 pottery grade, $19 per ton; market good. Grade 97 per cent pure offered at $10, f.o.b. quarry, water shipment. No. 1 grade in Ontario, $5.50, with good demand.

In Connecticut, No. 1 spar, $7 per ton; No. 2, $6.50. Pulverized, 60 mesh to 80 mesh, $18; 200 mesh, $25 per ton.

In New York, No. 1 crude, $8 per ton.

No. 1 Canadian ground, $20 per net ton, f.o.b. mill. No. 1 crude, $7 per short ton, f.o.b. mine.

In New Hampshire, ground, $17@$19 per ton. Prices advanced $1 per ton because of high labor costs.

Fluorspar—95 per cent CaF_2, 3 per cent SiO_2, $20 per net ton, c.i.f. New York in bond. Nominal.

Washed gravel, 85 per cent and over calcium fluoride, 5 per cent and under silica, $23.50 per ton; 85 per cent CaF_2 and not over 6 per cent silica, $23; 80 per cent CaF_2 and not over 5 per cent silica, $22.

[1]Price furnished by Foote Mineral Co., Philadelphia, Pa.

Ground spar in packages for glass and enameling trade, highest grade, $49; lower grade, $39 per ton.

No. 2 lump, 85 per cent CaF_2 and not over 5 per cent silica, $24 per ton.

All above prices except where noted, f.o.b. Middle Western mines. Market quiet.

Fuller's Earth—16 to 60 mesh, $18 per ton; 16 to 30 mesh, $17; 30 to 60 mesh, $18; 60 to 100 mesh, $14.50; 100 mesh and finer, $7.50; f.o.b. Florida mines. Market fair.

Garnet—Spanish grades, $60 per short ton, f.o.b. port of entry. Domestic Adirondack grades, $85 per ton, f.o.b. shipping points. Canadian, $70@$80, f.o.b. shipping points. Good demand for quality product.

Graphite—Ceylon lump, first quality, 5½@6c. per lb.; chip, 4½@5c.; dust, 3½@4c. Market quiet.

Mexican amorphous, $15@$35 per ton, New York.

Gypsum—Crushed rock, $3@$4.50 per ton. Ground, $3.50@$8.50, f.o.b. shipping points.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¼ in. and larger, $1.10 @$1.75 per net ton. Agricultural limestone, pulverized, $2.50@$4.50 per net ton, f.o.b. eastern shipping points.

Magnesite—Crude magnesite, $14 per ton; calcined $35@$37, f.o.b. shipping point in California. Market very good.

Dead-burned magnesite in sacks, $40 @$42, Chester, Pa.; in bulk, $32@$34, Chewelah, Wash.

Caustic calcined, Grecian, $50@$51, c.i.f. New York.

Manjak—Barbados, in 1 to 5 ton lots, grade "A," 9c. per lb.; grade "AA," 11c. per lb.; grade "CM," 13½c.; grade "CF," 12c.; grade "CL," 14½c. Market languid.

Mica—Scrap, $20 per ton; washer, 11c. per lb.; disk, 1½ in., 30c. per lb.; 2x2 in., 55c.; 2x3 in., 80c.; 3x4 in., $1.05; 3x5 in., $1.60; 4x6 in., $2 per lb., North Carolina mines.

One producer reports getting $4 per lb. for 4x6 in. grade and proportionate prices for largest sizes, whereas he has been unable to get prices quoted above for smallest sizes.

Ground mica, 60 mesh, $65 per ton; 80 mesh, $70; 120 mesh, $120; 140 mesh, $125; all f.o.b. North Carolina mills.

Washer and disk mica, $280 per ton; scrap $25 per ton, f.o.b. New Hampshire points.

[1]Monazite—Minimum 6 per cent ThO_2, 6@8c. per lb.

Ocher—"Yellow Peruvian," $20@$30 per ton, Georgia mines.

Phosphate — 77 to 76 per cent tricalcium phosphate, hard rock, $7.50 per ton, f.o.b. Jacksonville; 77 to 76 per cent pebble grades, $6.75; 75 to 74 per cent pebble, $5.50; 70 per cent pebble, $4.25; 66 to 68 per cent pebble, $3.75, f.o.b. Tampa.

In Tennessee, 65 per cent ground rock, $5.50@$6.50 per ton; 72 per cent washed, unground, $5.50@$6 per long ton; 75 per cent lump, free of fines, $6.50; 78 per cent, lump, $8@$8.50 per long ton.

Freight to Hamburg, Rotterdam, Bremen, $3; Scandinavia and Baltic ports, $3.50@$3.75 per ton.

Pumice Stone—Imported lump, 3@ 40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Imported lump, 1 in. diameter and up, 11½c. per long ton unit of sulphur; furnace size, 2½ in. diameter, 12c. per long ton unit; fines, through ½-in. mesh, 11½c. per long ton unit; cinder property of buyer, ex ship, Atlantic ports. Ore contains 50@51 per cent sulphur; cinder about 63 per cent iron.

Market dull, but some sales are being made to coast plants.

Silica—450 mesh, $31; 350 mesh, $25; 200 mesh, $20; 100 mesh, $8; all f.o.b. Illinois plant, water ground and floated for paints and polishes.

Glass sand, $2@$2.50 per ton; brick sand, $2@$2.25; moulding sand, $2@ $2.25; building sand, $2@$2.25; motor sand, $2@$2.25.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—Extra white, minus 200 mesh, $8.50 per ton; medium white, 180 mesh, $8; medium white, 160 mesh, $7.50, bags extra $1 per ton, f.o.b. Vermont.

Marked improvement in demand with increasing firmness in prices since Dec. 1. For the first time since the general business slump of 1920 one producer has contracted capacity of his plant for a year ahead.

Roofing grades, $6@$7 per ton; paper grades, $9@$14; Vermont.

Through 20 to 50 mesh, $7@$9 per ton; 100 to 200 mesh, $8@$16; steel workers' crayons, $1.25@$2.25 per gross, Vermont mills.

Gray-white, $8; yellow, $9; red, $12; North Carolina.

Grade A, 350 mesh, $22; grade B, 300 mesh, $18; grade C, $12 per ton, f.o.b. New York. Double air-floated talc, 325 mesh, $14.75 per ton.

Tripoli—Once ground, rose and cream colored, $16@$25; white, $18@$27; double ground, r. and c., $17@$25; w., $19@$30; air-float, r. and c., $25@$30; w., $35; super air-float, r. and c., $35@ $40; w., $40@$45. All per short ton in 200-lb. burlap bags with paper liners, minimum car, 30 tons, f.o.b. Missouri.

Mineral Products

Arsenious Oxide (white arsenic)—13½c. per lb.

Copper Sulphate—4.75c. per lb., car lots, domestic large crystals.

Sodium Nitrate—$2.50 per 100 lb., ex vessel Atlantic ports.

Potassium Sulphate—Basis 90 per cent, $45.85 per ton.

Sodium Sulphate—$24@$26 per ton, New York.

Ferro-Alloys

[1]Ferrocerium—$7 per lb.

Ferrochrome—1 to 2 per cent carbon, 30c. per lb.; 4 to 6 per cent carbon, 12c. per lb.

[1]Price furnished by Foote Mineral Co., Philadelphia, Pa.

Ferromanganese — Domestic, 78@82 per cent, $109 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, $40, f.o.b. furnace; 16@19 per cent, $38@$39.

Ferromolybdenum—$2@$2.50 per lb. of contained molybdenum for 50 to 55 per cent grades.

Ferrosilicon—10 to 12 per cent, $43 @$50 per gross ton, f.o.b. works; 50 per cent $82.50@$85 delivered.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten—88@95c. per lb. of contained W, f.o.b. works. Quiet.

[1]Ferro-uranium—35 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works.

Ferrovanadium — $3.50@$4 per lb. of V contained, f.o.b. works. Active.

Metal Products

Rolled Copper—Sheets, 21c.; wire, 15½c.

Lead Sheets—Full lead sheets, 10.25c. per lb.; cut lead sheets, 10.50c. in quantity, mill lots.

Nickel Silver—28c. per lb. for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 18.75c. per lb.; rods, 15.75c. per lb.

Zinc Sheets—9.25c. per lb., f.o.b. works.

Refractories

Bauxite Brick—$140@$145 per M. Pittsburgh, Pa.

Chrome Brick—$45@$47 per net ton, f.o.b. shipping point.

Firebrick—First quality, $42@$45 per M., Ohio and Kentucky works; $42@$45 Central Pennsylvania; second quality, $35@$38.

Magnesite Brick — 9-in. straights, $65@$68 per net ton, f.o.b. works.

Magnesite Cement—$47@$50 per net ton, f.o.b. Chester, Pa.

Silica Brick—$42@$45 per M., Pennsylvania; $50@$53 Alabama.

Zirkite—Powdered, 80 per cent ZrO_2, 5c. per lb.; 70 per cent, 2½c. per lb. Brick, straights, 75@95c. each.

The Iron Trade

Pittsburgh, Jan. 1, 1924

There are no prospects of prices either advancing or declining. The few weak spots recently apparent have practically all disappeared.

A little tubular goods business is now coming in from jobbers in the oil fields, and with the turn in oil rounded a good year in oil country tubular goods is expected.

Pig Iron—Market dull. Foundry firm at $22, Valley, on ordinary lots, up to $22.50 on carloads. Bessemer at $23, Valley, is better established. An investor has bought 5,000 tons at the full price. There is less chance than a week ago of shading the $21, Valley, asking price on basic iron.

Connellsville Coke—Market dull and unchanged. Spot furnace, $3.75@$4; spot foundry, $5@$5.50.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1922	1923	1922	1923	1922	1923
January	65.450	65.668	35.035	31.928	421.750	465.053
February	65.290	64.313	33.891	30.875	435.511	468.631
March	64.440	67.556	33.269	32.310	436.912	469.269
April	66.575	66.855	34.080	32.346	440.715	465.220
May	71.154	67.043	36.023	32.611	444.106	462.252
June	71.149	64.861	35.900	31.611	444.615	461.132
July	70.245	63.015	35.644	30.942	444.165	458.025
August	69.417	62.793	34.957	30.952	446.069	455.714
September	69.515	64.203	35.305	31.698	442.800	453.901
October	68.015	63.649	34.498	31.718	443.583	452.024
November	65.177	63.818	32.882	32.774	447.484	437.839
December	63.905	64.705	31.383	33.375	460.440	435.500
Year	67.528	64.873	34.406	31.929	442.346	457.047

New York quotations cents per ounce troy, 999 fine, foreign silver. London pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1922	1923	1922	1923	1922	1923
January	13.465	14.510	65.226	64.494	72.321	71.409
February	12.864	15.355	60.250	67.700	66.125	74.500
March	12.567	16.832	59.245	73.851	65.739	81.464
April	12.573	16.663	58.799	73.169	64.028	81.331
May	13.111	15.440	61.092	67.460	66.554	76.568
June	13.575	14.663	61.988	66.607	69.333	73.238
July	13.654	14.321	63.137	65.278	70.321	72.364
August	13.723	13.822	63.784	64.034	69.932	70.000
September	13.748	13.323	63.113	63.194	70.917	68.275
October	13.632	12.574	62.773	60.614	70.693	64.250
November	13.598	12.727	62.795	61.648	70.216	66.477
December	14.074	12.823	63.267	62.035	70.132	67.611
Year	13.382	14.421	62.123	65.840	68.859	72.291

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1922	1923	1922	1923	1922	1923
January	4.700	7.633	4.388	7.571	23.667	27.119
February	4.700	8.050	4.396	8.093	20.681	28.519
March	4.720	8.252	4.421	8.254	21.266	28.815
April	5.115	8.101	4.946	7.996	22.993	26.956
May	5.420	7.306	5.281	7.085	24.462	25.614
June	5.745	7.146	5.563	6.852	24.685	25.429
July	5.729	6.237	5.447	6.126	24.869	24.188
August	5.824	6.582	5.537	6.496	24.580	24.222
September	6.110	6.856	5.868	6.700	24.131	25.688
October	6.530	6.831	6.338	6.570	25.551	27.815
November	7.047	6.846	6.868	6.582	26.199	30.352
December	7.163	7.369	6.978	7.369	26.079	31.042
Year	5.734	7.267	5.503	7.141	24.097	27.147

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1922	1923	1922	1923	1922	1923
January	31.480	37.986	32.100	39.173	163.065	181.852
February	29.835	40.693	30.767	42.011	149.850	190.513
March	28.426	46.569	29.171	48.569	143.152	219.607
April	29.810	44.280	30.605	45.810	149.840	213.081
May	30.149	42.346	30.971	43.135	150.163	203.097
June	30.707	40.375	31.497	40.957	152.512	191.798
July	31.025	37.970	31.733	38.490	156.149	181.188
August	32.134	38.841	32.380	39.269	160.006	186.705
September	32.075	41.047	32.395	41.547	160.065	198.263
October	33.935	41.322	34.600	41.851	170.563	203.957
November	35.911	43.495	36.734	43.995	179.341	220.710
December	36.480	46.662	37.695	47.160	178.697	235.007
Year	31.831	41.799	32.554	42.664	159.450	202.148

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1922	1923	1922	1923
January	4.691	6.815	26.321	35.733
February	4.485	7.152	24.213	35.613
March	4.658	7.706	25.467	36.720
April	4.906	7.197	26.576	34.275
May	5.110	6.625	27.304	31.057
June	5.346	6.031	27.893	29.548
July	5.694	6.089	29.042	29.335
August	6.212	6.325	31.170	32.386
September	6.548	6.438	31.750	33.469
October	6.840	6.293	34.528	32.995
November	7.104	6.347	38.011	32.949
December	6.999	6.260	37.757	32.611
Year	5.716	6.607	30.003	33.058

St. Louis quotations, cents per pound. London, pounds sterling, per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1922	1923	1922	1923	1922	1923
January	4.463	6.884	49.960	72.731	97.260	112.462
February	4.416	7.290	48.295	70.636	89.545	113.273
March	4.319	8.885	50.204	70.808	87.500	110.846
April	4.980	8.380	52.280	69.260	87.500	116.840
May	5.467	7.477	54.885	68.000	85.529	115.007
June	5.145	6.839	55.115	67.769	87.212	115.615
July	5.091	7.097	55.000	66.980	90.180	116.000
August	5.315	7.753	57.593	65.212	98.370	116.000
September	6.580	7.633	67.640	63.000	117.280	116.000
October	6.905	8.005	72.560	61.769	109.440	116.923
November	6.584	9.156	71.521	61.917	108.000	124.479
December	6.382	9.365	72.300	60.000	113.600	125.000
Year	5.471	7.897	58.946	66.502	97.618	116.537

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1922	1923	1922	1923	1922	1923
January	21.55	29.27	20.15	27.35	21.34	28.77
February	21.46	29.79	19.71	28.15	20.88	27.21
March	21.35	32.03	19.96	31.79	20.83	31.77
April	22.50	32.77	21.26	32.77	22.70	32.77
May	26.36	31.87	26.87	29.83	25.96	32.46
June	26.96	30.27	26.96	28.34	25.96	29.81
July	26.77	28.47	26.33	26.52	25.97	27.7
August	30.44	28.27	27.18	26.77	30.81	26.77
September	35.27	28.26	34.70	26.26	36.75	26.72
October	35.27	26.96	31.77	25.01	33.40	25.52
November	33.52	24.79	29.37	22.57	30.55	23.60
December	29.87	24.54	26.34	22.62	27.69	23.72
Year	27.61	28.94	25.88	27.33	26.91	28.05

In dollars per long ton.

Monthly Crude Copper Production

	1923			
	August	September	October	November
Alaska shipments	6,353,425	8,507,154	8,819,469	8,651,360
Washoe smelter	17,100,000	16,100,000	19,000,000	17,800,000
Calumet & Arizona	3,046,000	3,386,000	3,226,000	3,688,000
Calumet & Hecla	(c)	(c)	(c)	(c)
Other Lake Superior	(c)	(c)	(c)	(c)
Chino	4,202,636	3,838,675	(c)	(c)
East Butte	(c)	(c)	(c)	(a)
Inspiration	(c)	(c)	(c)	(c)
Miami	5,144,000	4,676,000	5,590,000	5,883,000
Nevada Consolidated	5,881,420	5,999,167	(c)	(c)
New Cornelia	3,372,243	3,271,655	3,436,861	3,059,377
Old Dominion	2,015,000	2,040,000	2,314,000	(c)
Phelps Dodge	9,745,000	9,857,000	13,608,000	12,592,000
Ray	5,447,123	5,724,249	(c)	(c)
Shattuck Arizona	(c)	(c)	(c)	(c)
Southwest Metals Co.	1,072,283	960,415	800,000	(c)
United Verde	(c)	(c)	(c)	(c)
United Verde Extension	3,553,046	3,209,216	3,320,514	3,242,970
Utah Copper	20,521,352	19,033,832	(c)	(c)
Others, estimated	18,000,000	18,500,000	16,000,000	17,000,000
Total United States	.....	.....	.....	.....
Imports: Ore and concentrates, matte	15,750,000	14,738,801	14,738,881	12,682,229
Imports of black and blister, unrefined	30,379,000	36,810,274	36,810,274	44,438,675
Imports of refined and old	2,999,000	10,493,214	10,493,274	3,207,054
Grand total	.....	.....	.....	.....
Backus & Johnston	(c)	(c)	(c)	(c)
Boleo	1,422,148	1,237,005	1,248,030	1,454,198
Cananea	(c)	(c)	(c)	(c)
Cerro de Pasco	(c)	(c)	(c)	(c)
Chile	(c)	(c)	(c)	(c)
Cons. M. & S. of Canada	(a)	(a)	(a)	(a)
Falcon Mines	502,740	466,000	500,600	(c)
Furukawa	2,585,285	3,001,603	3,246,061	(c)
Granby Cons.	3,436,369	2,876,592	2,606,372	2,692,616
Katanga	12,266,415	12,072,375	11,428,513	10,460,520
Mount Morgan	858,000	822,000	680,000	(c)
Mount Lyell	1,012,000	1,164,000	844,000	(c)
Phelps Dodge Mexican	1,829,000	3,417,000	3,331,000	2,373,000
Sumitomo	2,372,289	2,230,707	(c)	(c)
Wallaroo & Moonta	748 702	827,787	3,415,596	(c)

Comparative Monthly Copper Production

	1920	1921	1922	1923
January	121,903,744	90,596,597	32,010,292	(b) 112,341,000
February	117,540,000	86,682,941	45,957,530	(b) 102,641,000
March	120,309,316	91,046,345	55,705,760	(b) 122,202,000
April	116,078,871	46,946,523	(b) 76,601,000	(b) 117,914,000
May	114,964,207	25,310,511	(b) 88,714,000	(b) 124,785,000
June	116,107,856	24,623,693	(b) 93,740,000	.....
July	109,729,610	22,033,739	(b) 91,000,000	.....
August	112,460,254	23,248,598	(b) 101,188,000	.....
September	104,919,562	23,855,316	(b) 96,408,000	.....
October	105,231,571	23,231,572	(b) 103,273,000	.....
November	106,700,178	28,341,442	(b) 102,845,000	.....
December	95,709,009	26,629,137	(b) 103,003,000	.....

(a) No copper produced during this month. (b) Department of Commerce. (c) Not available.

Company Reports

Broken Hill South, Ltd.

Lead and Zinc; Australia

A report of the operations of the Broken Hill South, Ltd., for the year ended June 30, 1923, states that the successful financial result of the year's operations is due to the high lead price ruling throughout the year and to the substantial profit accruing from the treatment for lead of accumulated dump slimes. The net profit for the year amounted to £322,780, after providing £30,000 for future taxation, and £30,722 for depreciation of plant.

The following summarizes the year's financial results:

	£	s.	d.	£	s.	d.
Balance, appropriation account	167,425	6	1			
Less dividends Nos. 3 and 4	160,000	0	0			
				7,425	6	1
Net profit for year				322,780	15	3
Plant appropriation (not expended)				11,174	11	8
				341,380	13	0
	£	s.	d.			
Dividends, Nos. 5 and 6	120,000	0	0			
Appropriation debenture sinking fund	13,333	0	0			
Appropriation plant and development	80,000	0	0	213,333	0	0
Balance, appropriation account				128,047	13	0

Since the end of the financial year, Dividend No. 7, of 1s. 6d. per share, £60,000, was paid on Aug. 10, 1923.

As in the previous year, the greater part of the profit has been derived from dump slime treatment. The total gross profit shown in working account was £382,905, including £61,373 from previous periods. Of this amount, £243,672 came from dump slime, against £139,233 from crude ore. Excluding profits derived from earlier production, the last year's operations gave a gross working profit of £321,532, dump slime providing £204,305 of this total; crude ore was responsible for £117,226.

Though before the end of the current year the substantial profits now being obtained from the treatment of old slime dumps for lead concentrate will cease, the augmentation of profits should accrue from: (a) Full benefit of coarse zinc flotation. (b) Treatment of de-leaded slime residue dumps for zinc concentrate. (c) Possibility of increased rate of treatment of crude ore.

Santa Gertrudis Co., Ltd.

Gold, silver; Pachuca, Mexico

A report of the operations of the Santa Gertrudis Co., Ltd., for the year ended June 30, 1923, states that 135,011 tons of ore was sold, containing £260,880 gross value, of which 14.4 per cent was in the form of gold and 85.6 per cent in silver. This tonnage contained 8,299 fine oz. of gold and 1,522,588 fine oz. of silver. The average rate of sterling exchange was $4.5645.

The managing director reports that the reserves at June 30, 1923, are estimated at 82,476 dry short tons, containing 4,835 fine oz. of gold and 885,215 fine oz. of silver. The recoverable amount is estimated at 4,351 fine oz. of gold and 796,693 fine oz. of silver.

Milling operations during the year averaged 89 per cent of the full capacity of the mill.

During the period under review there were treated 520,671 dry short tons of ore, having a gross assay value of £914,188, or £1 15s. 1d. per ton. The bullion recovered contained 21,105 fine oz. of gold, and 4,932,366 fine oz. of silver. Of this tonnage 133,568 tons was received from the Santa Gertrudis mine, and 387,103 tons from the several properties of the Inversiones Co.

The profit derived from the treatment of the Santa Gertrudis mine ores and that accruing to the Inversiones company, after writing off depreciation of plant and machinery of the Beneficiadora company and allowing for development expenses incurred by the Inversiones company, amounted to $369,751.

Mining Companies Improve Dividend Record of Previous Quarter

The following dividends were paid by mining and metallurgical companies during December:

Companies in the United States	Situation	Per Share	Total
American Metal	U. S. and Mex.	$0.75 Q	$402,000
American Metal pfd	U. S. and Mex.	1.75 Q	87,500
American Smelting & Refining pfd	U. S. and Mex.	1.75 Q	875,000
California Rand Silver	Calif.	0.02 M	25,600
Calumet & Arizona, c	Ariz.	0.50 Q	321,261
Calumet & Hecla Consolidated, c	Mich.	0.50 I	1,002,751
Cardiff Mining & Milling, s.l.	Utah	0.10 X	50,000
Dragon Consolidated Mining, s.g.c.l.	Utah	0.005 X	9,375
Federal Mining & Smelting pfd., s.l.	Idaho	1.75 Q	210,00
Great Northern Iron Ore	Minn.	2.00 X	3,000,00
Hecla Mining, s.l.	Idaho	0.25 Q	250,000
Homestake Mining, g	S. D.	0.50 M	125,580
Inland Steel	Minn.	0.625 Q	629,379
Mother Lode Coalition, c	Alaska	0.50 SA	1,250,000
National Lead	U. S.	2.00 Q	413,108
National Lead pfd	U. S.	1.75 Q	426,433
St. Joseph Lead	Mo.	0.50 Q	774,684
St. Mary's Mineral Land, c	Mich.	1.00 X	160,000
Texas Gulf Sulphur	Texas	2.00 Q	1,270,000
Union Copper Land & Mining	Mich.	0.50 X	40,000
U. S. Steel	U. S.	1.50 Q	7,624,537
United Verde Copper	Ariz.	2.00 Q	600,000
Utah Copper	Utah	1.00 Q	1,624,490
Companies in other countries			
Chile Copper	Chile	0.625 Q	2,375,000
Hollinger Consolidated Gold	Ont.	0.10 Z	492,000
Lucky Tiger Combination, g	Sonora	0.16 QY	114,454
McIntyre Porcupine, g	Ont.	0.25 Q	182,014
Mexico Mines of El Oro, g.s.	Mexico	10 sh.	£105,000
N. Y. & Honduras Rosario, s	Honduras	$0.25 X	50,000

Q, quarterly; M, monthly; I, initial; X, paid irregularly; SA, semi-annually Z, two dividends of $246,000 each, paid on Dec. 3, and 31; Y, includes extras; c, copper; l, lead; s, silver; g, gold.

Calumet & Arizona reduced its regular quarterly dividend from $1 to 50c. The new Calumet & Hecla Consolidated compay paid its first dividend, the regular dividend which was due in September having been omitted. With the new arrangement, old Calumet & Hecla shareholders get $7.92 per share of old stock, compared with $10 which they were receiving; Ahmeek shareholders get $1.34 compared with $1.50. On the other hand, stockholders of Allouez, Osceola, and Centennial participate in the dividend, whereas they probably would have received nothing had not the merger taken place, as their properties are closed down. The dividend will probably be a quarterly one.

Cardiff, in the Big Cottonwood Canyon, Utah, resumed dividends after a lapse of three years; likewise the Dragon Consolidated, which has a mine near Tintic. Great Northern Iron Ore Properties doubled its previous dividend of $1 on certificates of beneficial interest. The last dividend was paid in April. The mines produced 9,400,000 tons of ore in 1923, compared with 8,130,481 tons in 1912, the best previous year.

Hecla Mining increased its dividend from 15c. to 25c., though it has not produced anything since the fire last summer. With a resumption of operations early in the new year, the old dividend of 50c. will no doubt be resumed. Isle Royale does not report the customary December distribution; it paid 50c. in September. St. Mary's Mineral Land had paid nothing since a $3 distribution in March. U. S. Steel increased its dividend from $1.25 to $1.50, this small increase per share amounting to over a million and a quarter dollars. United Verde has no regular dividend policy for its twenty-two or so stockholders, the last payment being at the rate of $3 a share which was made in September.

The Union Copper Land & Mining, a Michigan company with timber holdings as well as mineral lands, surprised stockholders with a 50c. distribution, this being the first return that has been made since 1908, according to Mr. Weed's Handbook.

The recession in price of metals, together with the large amount of development and exploratory work now going on, led the directors of the Utah Apex to conserve the cash resources of the company and pass the dividend. The last payment was 25c. in September.

All in all, stockholders in mining companies cannot complain, the total distribution of the companies listed in the above table amounting to about twenty-five million dollars, compared to about eighteen million paid three months ago, the corresponding quarterly period.

MINING STOCKS

Week Ended December 29, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	...	...	50	June 23, Q	$1.50
Alaska-Br. Col.	N. Y. Curb	*42	*42	*42	.....	....
Allouez	Boston	...	...	*16	Mar. '19	1.00
Anaconda	New York	36⅞	35⅞	36	De.15, Ja.21, Q	0.75
Arcadian Consol.	Boston	1⅛	1⅛	1⅛	.....	....
Ariz. Com'l	Boston	8	8	8	July '23,	0.50
Calaveras	N. Y. Curb	...	...	1¾	.....	....
Calumet & Arizona	Boston	42	42	42	De.7, De.24 Q	0.50
Cal. & Hecla (New)	Boston	18⅛	17⅝	17⅝	De. 1, De. 17	0.50
Centennial	Boston	...	...	7	Dec. '18, SA	1.00
Cerro de Pasco	New York	45⅞	45	45⅛	Oc.18, No.1, Q	1.00
Chile Copper	New York	27⅛	26⅛	27⅛	De.1, De.29, Q	0.62½
Chino	New York	17⅞	17⅛	17⅛	Sept. '20, Q	0.37½
Con. Cop.Min.(New)	N. Y. Curb	1⅞	1¼	1¼	.....	....
Copper Range	Boston	23¼	23⅛	23⅛	May '23, Q	1.00
Crystal Copper	Boston Curb	73	68	72	.....	....
Davis-Daly	Boston	4¼	4¼	4¼	Mar. '20, Q	0.25
East Butte	Boston	4½	4½	4½	Dec. '19, A	0.50
First National	Boston Curb	32	28	28	Feb. '19, SA	0.15
Franklin	Boston	*85	*85	*85	.....	....
Gadsden Copper	Boston Curb	*40	*40	*40	.....	....
Granby Consol.	New York	15½	13¼	14⅜	May '19, Q	1.25
Greene-Cananea	New York	14¼	13⅜	14	Nov. '20, Q	0.50
Hancock	Boston	...	...	1⅞	.....	....
Howe Sound	N. Y. Curb	2⅜	2⅜	2⅜	Ja.2, Ja 15	0.05
Inspiration Consol.	New York	24½	24	24	De. 20, Ja. 7, Q	0.50
Iron Cap	Boston Curb	3½	3¼	3¼	May 23, K	0.15
Isle Royale	Boston	17½	16½	17	Se. 1, Se. 15,	0.50
Kennecott	New York	34	33¾	33¾	De. 7, Ja. 2, Q	0.75
Keweenaw	Boston	*75	75	*75	.....	....
Lake Copper	Boston	1⅛	1⅛	1⅛	.....	....
Magma Copper	New York	30⅛	30	30	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	1⅜	1⅜	1⅜	.....	....
Mass Consolidated	Boston	...	...	*99	Nov. '17, Q	1.00
Miami Copper	New York	21⅞	21⅜	21⅞	No. 1, No. 15, Q	0.50
Michigan	Boston	1	1	1	.....	....
Mohawk	Boston	32	31½	*32	Se. 22, Oc. 13,	1.00
Mother Lode Con.	New York	8¼	7⅞	7⅞	De.14, De.31	0.50
Nevada Consol.	New York	12	11⅛	11⅛	Sept. '20, Q	0.25
New Cornelia	Boston	*16⅛	*16	*16⅛	Au. 3, Au, 20, Q	0.25
New Dominion	N. Y. Curb	2½	2⅜	2½	.....	....
North Butte	Boston	1⅞	1⅞	1⅞	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*84	*77	*77	.....	....
Old Dominion	Boston	15	15	15	Dec. '18, Q	1.00
Osceola	Boston			31½	June '23, Q	1.00
Phelps Dodge	Open Mar.	†145	†135	....	De.20, Ja. 2 Q	1.00
Quincy	Boston	19¼	19⅛	19⅛	Mar. '20, Q	1.00
Ray Consolidated	New York	11⅛	11	11⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*20	*13	*13	.....	....
St. Mary's Min. Ld.	Boston	...	...	*32	No.9,De.11, K	1.00
Seneca Copper	New York	5⅛	5	5⅛	.....	....
Shannon	Boston	*40	*40	*40	Nov. '17, Q	0.25
Shattuck Arizona	New York	6¾	6	6½	Jan. '20, Q	0.25
South Lake	Boston	...	...	¼	.....	....
Superior & Boston	Boston	*75	*65	*65	.....	....
Tenn. C. & C. cfs.	New York	9½	9	9⅛	De.31, Ja.15, Q	0.25
Tuolumne	Boston	*45	*41	*41	May '13,	0.10
United Verde Ex.	N. Y. Curb	28	27	27⅛	Ja.1, Fe.1, Q	1.00
Utah Consol.	Boston	*1	*1	*1	Sept '18,	0.25
Utah Copper	New York	65	63	64⅛	De.3, De.15, Q	1.00
Utah Metal & T.	Boston	*50	*27	*30	Dec. '17,	0.30
Victoria	Boston	...	...	*70	.....	....
Winona	Boston	*20	*20	*20	.....	....
Wolverine	Boston	...	...	5¾	.....	....
NICKEL-COPPER						
Internat. Nickel	New York	14⅛	13⅛	13⅝	Mar.' 19,	0.50
Internat. Nickel pfd.	New York	79	78⅛	79	Oc.11, No.1 Q.	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	2⅛	2	2⅛	.....	....
National Lead	New York	148	138¾	143	De.14, De.31, Q	2.00
National Lead pfd.	New York	...	...	111	No. 23, De. 15	1.75
St. Joseph Lead	New York	23⅜	22⅜	23	De.9, De.20	0.50
ZINC						
Am. Z. L. & S.	New York	8⅛	6⅞	8⅛	May '20,	1.00
Am. Z. L. & S. pfd.	New York	29	24½	29	Nov. '20, Q	1.50
Butte C. & Z.	New York	5	4⅞	4⅞	Mar. '23,	0.50
Butte & Superior	New York	15	14⅛	14½	Je. 15, Je. 30, Q	0.50
Callahan Zn-Ld	New York	4¾	4⅛	4⅛	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	145	145	145	Ja.31, Fe.,9	2.00
United Zinc	N. Y. Curb	*30	*25	*25	.....	....
Yellow Pine	Los Angeles	...	...	*70	June '23, Q	0.03
SILVER						
Alvarado	N. Y. Curb	1⅛	*75	1⅛	.....	....
Batopilas Mining	New York	¼	¼	¼	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*24½	*22½	*23	May '20, K	0.03
Candelaria	N. Y. Curb	*3	*2	*3	.....	....
Castle-Trethewey	Toronto	*57	*57	*58	.....	....
Coniagas	Toronto	...	...	2.35	Oc.19, No.1, '23	0.02½
Crown Reserve	Toronto	*75	*73	*75	Jan. 17,	0.05
Kerr Lake	N. Y. Curb	2⅛	2	2⅛	Oc.1, Oc. 15, Q	0.12½
La Rose	Toronto	*21	*21	*21	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*13½	*13	*13	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	3.10	3.05	3.10	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6½	6½	6⅝	Ja.1, Ja.21, QX	0.30
Ontario Silver	New York	7⅛	6⅞	6⅞	Jan. '19, Q	0.50
Temiskaming	Toronto	*33½	*33	*33½	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅛	⅛	⅛	.....	....
Alaska Juneau	New York	1⅛	⅞	1	.....	....
Boundary Red M.	N. Y. Curb	...	...	*12	.....	....
Carson Hill	Boston	2½	2	2	.....	....
Cresson Consol. G.	N. Y. Curb	3⅛	3⅛	3⅛	De.31, Ja.10, Q	0.10
Dome Mines	New York	19⅝	19⅛	19⅛	De.31, Ja.2, Q	0.50
Golden Cycle	Colo. Springs	1.08	1.07	1.08	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	11.80	11.55	11.80	De.13, Ja.3.M	0.05
Homestake Mining	New York	57	55	55	De.20, De.26 M	0.50
Kirkland Lake	Toronto	*18	*17	*17	.....	....
Lake Shore	Toronto	3.50	3.45	3.48	No.1, No.15'23 Q	0.02
McIntyre-Porcupine	New York	18½	17½	17½	De. 1, Ja. 2,	0.25
Portland	Colo. Springs	*54	*52	*52	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1⅛	1 3/16	1⅛	.....	....
Tom Reed	Los Angeles	*55	*52	*55	Dec. '19,	0.02
United Eastern	N. Y. Curb	*99	*91	*96	Oc.8, Oc.28, Q	0.15
Vipond Cons.	Toronto	*95	*94½	*94½	.....	....
Wright-Hargreaves	Toronto	....	....	2.75	Se.15, Oc.1, Q	0.02½
Yukon Gold	N. Y. Curb	*66	*65	*65	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*15	*14	*14	.....	....
Con. Cortez	N. Y. Curb	*58	*54	*58	.....	....
Con. Virginia	San Francisco	5⅛	4½	5⅛	.....	....
Continental Mines	N. Y. Curb	4	4	4	.....	....
Dolores Esperanza	N. Y. Curb	*70	*50	*50	Jy. 1, Jy.10 Q	0.05
Jib Consol	N. Y. Curb	...	...	*65	.....	....
Tonopah Belmont	N. Y. Curb	*55	*50	*50	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*39	*38	*38	Se.22, Oc.10	0.10
Tonopah Extension	N. Y. Curb	1⅛	1⅛	1⅛	De. 11, Ja. 1	0.05
Tonopah Mining	N. Y. Curb	1¼	1¼	1¼	Se. 30, Oc. 1	0.07½
Unity Gold	N. Y. Curb	1 1/16	*88	*88	.....	....
West End Consol.	N. Y. Curb	*62	*55	*60	Mar. '23, Q	0.05
SILVER-LEAD						
Ahumada	Boston Curb	4¼	4¼	4¼	De.15, Ja.2, X	0.10
Bingham Mines	Boston	...	...	16	Sept. 19, Q	0.25
Cardiff M. & M.	Salt Lake	92	83	83	Dec. '20,	0.15
Chief Consol.	Boston Curb	3½	3 7/16	3 7/16	Oc.10, No.1, Q	0.10
Columbus Rexall	Salt Lake	*32	*29⅛	*31	Aug. '22,	0.03
Consol. M. & S.	Montreal	31½	29⅛	31	Oct. '20, Q	0.62½
Erupcion	Boston Curb	...	...	1⅛	De.15, Ja.2, X	0.125
Federal M. & S.	New York	10	9¼	9¼	Jan., '09,	1.50
Federal M. & S. pfd.	New York	41½	40	41	No. 26, De. 15,	1.75
Florence Silver	Spokane	*15	*13	*15	Apr. '19, Q.X	0.01
Hecla Mining	N. Y. Curb	9	8⅞	9	No.15, De.15	0.25
Iron Blossom Con.	N. Y. Curb	....	....	*31	Oct.25, '23,	0.02
Marsh Mines	N. Y. Curb	*14	*13	*14	June '21, I	0.02½
Park City	Salt Lake	4.00	4.00	4.00	Se.15, Oc.1 Q	0.12
Park Utah	N. Y. Curb	4	4	4	Ja. 1, Q	0.15
Prince Consol.	Salt Lake	...	....	*75	Nov. '17,	0.02
Silversmith	Spokane	*32	*30	*30	Oc. 1, Oc. 10	0.01
Simon Silver Lead	N. Y. Curb	*2	*1	*2	.....	....
Snowstorm Silver-L.	N. Y. Curb	...	...	*46	.....	....
Tamarack-Custer	Spokane	1.36	1.35	1.35	Se.30, Oc.1, K	0.02
Tintic Standard	Salt Lake	3.75	3.75	3.75	Ja. 5, X	0.25
Utah-Apex	Boston	....	....	2½	June '23, Q,X	0.50
IRON						
Bethlehem Steel	New York	54¼	51⅝	53¾	De.1, Ja.2, Q	1.25
Char. Iron	Detroit	1 1/16	⅞	1 1/16	.....	....
Char. Iron pfd	Detroit	1⅞	1⅞	1⅞	.....	....
Colorado Fuel & Iron	New York	26½	22	26½	No 10, No.26 Q	2.00
Col. Fuel & Iron pfd.	New York	...	...	102	Feb '23, Q	2.00
Gt. North'n Iron Ore	New York	29⅜	27½	28⅛	De.10, De.27	2 00
Inland Steel	N. Y. Curb	...	...	46	No.15, De.1Q	0.62½
Mesabi Iron	N. Y. Curb	...	...	5	.....	....
Replogle Steel	New York	12	10½	10⅞	.....	....
Republic I. & S.	New York	51⅞	48⅞	51	May '21	1.50
Republic I. S. pfd.	New York	90	89½	89½	De.15, Ja.2 Q	1.75
Sloss-Sheffield S. & I.	New York	63¼	57¼	61½	Feb.'21,	1.50
Sloss-Shef. S.&I. pfd.	New York	...	...	84	De.20, Ja.2, Q	1.75
U. S. Steel	New York	99½	94⅞	99	No.29, De.29, Q	1.50
U. S. Steel pfd.	New York	119⅞	119½	119⅝	No.4, No.28, Q	1.75
Virginia I. C. & C.	New York	53	53	53	De.15, Ja. 2	1.50
Virginia I.C.&C.pfd.	New York	...	...	80	De.15, Ja.22	2.50
VANADIUM						
Vanadium Corp.	New York	31⅛	29⅝	30⅛	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	30	29½	29½	Se.29, Oc.15 Q	1.00
Asbestos Corp. pfd.	Montreal	61	60¼	61	Se.29, Oc.15 Q	1.50
SULPHUR						
Freeport Texas	New York	12⅛	11⅛	12	Nov. '19, Q	1.00
Texas Gulf	New York	61⅛	60¼	61⅛	De.1, De.15 QX	2.00
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3⅛	2⅛	3⅛	.....	....
MINING, SMELTING AND REFINING						
Amer. Metal	New York	43¼	41½	42⅞	No. 17, De. 1, Q	0.75
Amer. Metal pfd.	New York	...	...	106½	No.19, De 1, Q	1.75
Amer. Sm. & Ref.	New York	59½	57⅞	58⅝	De.11, No.1, Q	1.25
Amer. Sm.& Ref. pfd	New York	95⅞	95½	95⅞	No.9, De.1,	1.75
U. S. Sm. R. & M.	New York	20	18	19⅜	Jan. '21, Q	0 50
U.S. Sm.R.& M. pfd.	New York	39½	38⅜	38⅜	Ja.7, Ja.15 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.